



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

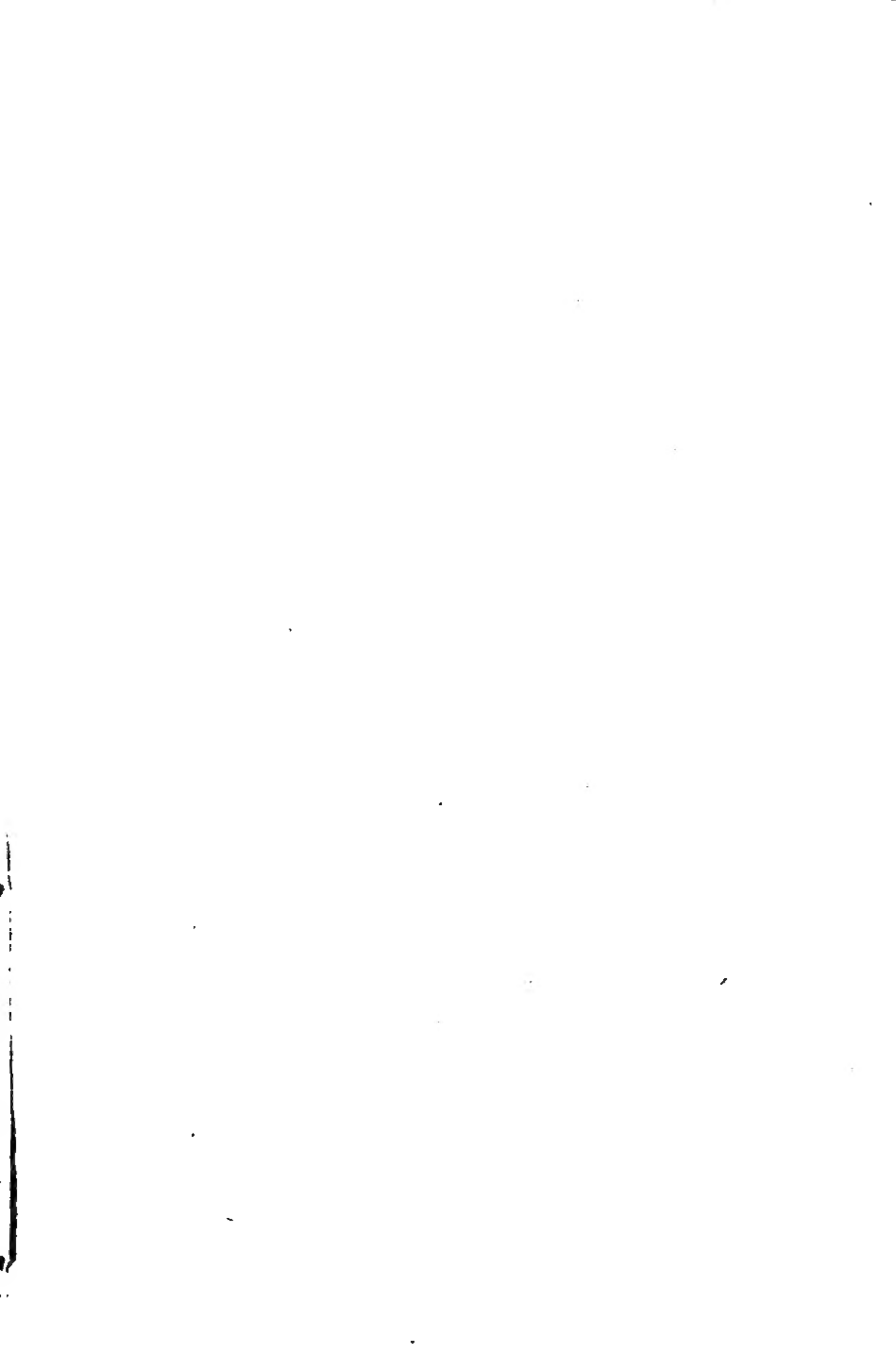
Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>



**DISEASES OF THE KIDNEYS,
URETERS AND BLADDER**

DISEASES OF THE KIDNEYS, URETERS AND BLADDER

WITH SPECIAL REFERENCE TO THE DISEASES IN WOMEN

BY

HOWARD A. KELLY, M.D., LL.D.

PROFESSOR OF GYNECOLOGICAL SURGERY IN THE JOHNS HOPKINS UNIVERSITY, AND GYNECOLOGIST
TO THE JOHNS HOPKINS HOSPITAL, BALTIMORE

AND

CURTIS F. BURNAM, M.D.

ASSOCIATE IN GYNECOLOGY JOHNS HOPKINS HOSPITAL

VOLUME II

WITH 628 ILLUSTRATIONS, FOR THE MOST PART BY
MAX BRÖDEL

NEW YORK AND LONDON
D. APPLETON AND COMPANY

1914

**HARVARD MEDICAL LIBRARY
IN THE
FRANCIS A. COUNTWAY
LIBRARY OF MEDICINE**

17
D
1914
1
Vol 2

**COPYRIGHT, 1914, BY
D. APPLETON AND COMPANY**

CONTENTS.

CHAPTER	PAGE
XVIII. ESSENTIAL HEMATURIA AND NEPHRALGIA	1
Etiology and Pathology	2
Clinical Symptoms	5
Diagnosis	6
Treatment	6
Illustrative Cases	8
XIX. TUBERCULOSIS OF THE KIDNEY	19
History	19
The Occurrence of Kidney Tuberculosis	21
Portal of Entry of Tubercle Bacillus to the Kidney	26
Pathology	31
Symptomatology	53
Diagnosis	61
Prognosis	71
Treatment	73
Tuberculosis of the Ureters	85
Tuberculosis of the Bladder	86
XX. RENAL AND URETERAL STONES	90
History	90
Etiology	92
Pathological Changes in the Kidney Produced by Stone	104
Symptoms of Stone in the Kidney	106
Diagnosis	114
Summary	163
XXI. BLADDER AND URETHRAL STONES	165
Bladder Stones	165
Stone in the Urethra	183
XXII. SYPHILIS, ECHINOCOCCUS, ACTINOMYCOSIS, AND OTHER PARASITIC	
DISEASES OF THE URINARY ORGANS	187
Syphilis	187
Echinococcus Disease	188
Bilharziosis	192
Actinomycosis	196
Chyluria	201

CHAPTER	PAGE
XXIII. PYELITIS	203
Pyelitis in General	203
Pyelitis in Children	212
Pyelitis of Pregnancy and the Puerperium	213
XXIV. PYELONEPHRITIS, PYONEPHROSIS, MULTIPLE ABSCESES AND AFFECTED INFARCTS OF KIDNEY, PERIRENAL INFLAMMATION	216
Inflammation of the Kidney Pelvis or Parenchyma	216
Perirenal Inflammations	231
XXV. NEW GROWTHS OF THE KIDNEY, URETER, PERIRENAL TISSUES, AND ADRENAL GLANDS	236
Tumors of the Kidney and Ureter	236
Adrenal Tumors	265
Perirenal Tumors	270
Cysts of the Kidney, Other than Polycystic Kidney	271
Polycystic Kidney	275
XXVI. SURGICAL TREATMENT OF BRIGHT'S DISEASE	288
General Considerations	288
History of Surgical Treatment	289
Indications for Operation	292
Preparation for Operation	293
Technique of Operation	293
Results of Operation	294
XXVII. TRAUMATIC INJURY OF THE KIDNEY AND URETER	296
Injuries to the Kidney	296
Injuries to the Ureter	303
XXVIII. MALDEVELOPMENT OF THE KIDNEY AND URETER	307
Maldevelopment as to Number	307
Maldevelopment as to Form	312
Maldevelopment as to Position	321
Embryological Notes on the Maldevelopment of the Ureter and Renal Pelvis	326
Malformation of Renal Pelvis and Ureter of Lesser Degree	331
Ureters (Single and Supernumerary) with Abnormal Orifices	336
Bibliography	348
XXIX. STRICTURE AND OTHER DISEASES OF THE URETER	349
XXX. ANATOMY AND TOPOGRAPHY OF THE FEMALE BLADDER AND URETHRA	361
The Bladder	361
The Urethra	370
XXXI. DIVERTICULUM OF THE BLADDER	372
Occurrence	372
Etiology	375

CONTENTS.

vii

CHAPTER

PAGE

Symptoms	375
Diagnosis	376
Treatment	379
Literature	384
XXXII. EXSTROPHY OF THE BLADDER	385
Treatment	389
Fissura Vesicæ Superior	403
XXXIII. VESICAL, URETERAL, AND URETHRAL FISTULÆ	404
Vesical Fistulæ	404
Ureteral Fistula	435
Urethral Fistula	441
XXXIV. CYSTITIS	443
Etiology	443
Symptoms	449
Diagnosis	449
Treatment	456
Contracted Bladder	477
Ulcer of the Bladder	479
Cystitis in Children	480
Exfoliative Cystitis	480
Syphilis of the Bladder	483
Malakoplakia	485
XXXV. INJURIES OF THE BLADDER AND URETHRA	486
Etiology	488
Classification	489
Sequelæ	489
Diagnosis	480
Treatment	492
XXXVI. DISEASES OF THE PREVESICAL SPACE	497
Literature	505
XXXVII. TUMORS OF THE BLADDER	506
Classification	507
General Consideration	508
Tumors of the Bladder in Children	520
Symptoms of Tumors of the Bladder	529
Treatment	533
XXXVIII. NEUROSES OF THE BLADDER	553
Sensory Disturbances	554
Incontinence of Urine	557
Enuresis	560
Retention of Urine	562

CHAPTER	PAGE
XXXIX. MALFORMATIONS OF THE URETHRA	564
Absence of the Urethra	564
Double Urethra	564
Hypospadias or Vaginal Urethra	565
Epispadias	568
XL. PROLAPSE OF THE URETHRAL MUCOSA	574
Prolapse of the Urethra in Adults	574
Prolapse of the Urethra in Girls	577
XLI. URETHRITIS	579
Acute Urethritis	579
Chronic Urethritis	579
Inflammation of Skene's Glands	581
External Urethritis	582
Suburethral Abscess	582
Syphilis of the Urethra	583
Stricture of the Urethra	585
Periurethritis Chronica	587
XLII. NEW GROWTHS OF THE URETHRA	588
Caruncle	588
Mucous Polypi	591
Fibroma, Myoma and Fibromyoma	592
Carcinoma	593
Sarcoma	597

LIST OF ILLUSTRATIONS.

FIG.	PAGE
275.—Microscopical section of tubercular kidney	33
276.—Section of kidney from papilla to surface	34
277.—Tubercular process in upper pole of kidney	36
278.—Kidney showing disseminated tuberculosis of cortex of its upper pole with secondary destruction of papilla	39
279.—Diagrammatic representation of upper pole of kidney shown in last figure	40
280.—Large tubercular kidney	41
281.—Tuberculosis limited largely to the lower pole of kidney, which has two pelves and double blood supply	42
282.—Tuberculosis of left kidney	43
283.—Massive tuberculosis of the kidney	44
284.—Tuberculosis of kidney and ureter	46
285.—Tuberculosis of the kidney with cystic transformation of upper pole	48
286.—Tuberculosis of kidney and ureter	50
287.—Transverse section of the ureter	52
288.—Early tuberculosis of the ureter due to tuberculosis of the kidney	53
289.—More advanced stage of tuberculosis of the ureter	54
290.—Still more advanced stage of tuberculosis of the ureter	55
291.—Healed tuberculosis of the ureter	55
292.—Tubercular kidney	66
293.—Nephrectomy from above downward for tuberculosis of the kidney	77
294.—Second step in nephrectomy from above downward for tuberculosis	78
295.—Nephrectomy from below upward for tuberculosis of the kidney	79
296.—Rapid removal of kidney, clamp method	80
297.—Kidney ureter and part of the bladder including ureteral orifice removed in one piece for tuberculosis of parts concerned	81
298.—View of the abdomen showing position and extent of incisions necessary for removal of specimen shown in preceding figure	82
299.—Cystoscopic view of right and left ureteral orifices; tuberculosis of left kidney	86
300.—Cystoscopic view of patch of discrete tubercles on mucous membrane of bladder	87
301.—Coral calculi choking pelvis and calices of kidney	94
302.—Large coral stone in pelvis of kidney, extending into calices	95
303.—Immense stones filling lower half of kidney, with normal upper half	95
304.—Large bilateral coral stones filling pelvis and calices of both kidneys, and making perfect casts of them	96
305.—Ureteral calculus presenting a smooth and highly polished surface	97
306.—Ureteral stone with grooved passage for urine	97
307.—Ureteral calculus forming a hollow shell that is obviously no obstacle to the excretions of urine	97
308.—Hydronephrosis and hydro-ureter of right kidney due to obstruction of ureter by stone about 10 cm. from vesical orifice	100
309.—Chain of pocketed stones extending several inches down ureter	101

FIG.	PAGE
310.—Enormous hydronephrosis and hydro-ureter with 47 stones in vesical end of ureter	102
311.—Stones in kidney associated with distended pelvis and calices	104
312.—Massive hydronephrosis due to stone in upper end of ureter	105
313.—Section through kidney shown in last figure, showing size and site of stones	106
314.—Large stone in pelvis of kidney and calices with complete destruction of the kidney	107
315.—Stone in the pelvis of the kidney	108
316.—Small stone measuring 12x6x4 mm.; passed spontaneously	110
317.—Long calculus passed spontaneously	111
318.—Palpation of ureteral stone through the rectum	118
319.—Stone protruding from ureteral orifice into the bladder	119
320.—Prolapse of vesical end of ureter into bladder, due to stone	120
321.—Determination of the distance of an obstruction in the ureter from the bladder	121
322.—Gouged renal catheter holding in its eye a small fragment of stone	121
323.—Bilateral stone kidney; large coral stone filling pelvis and calices of right kidney	122
324.—Renal catheter entering pelvis of kidney and striking a large branched stone	123
325.—Wax-tipped catheter scratched on both sides	124
326.—Waxing tip of renal catheter	125
327.—Wax-tipped catheter	126
328.—Flat facet on wax-tipped catheter, due to rubbing side of speculum	126
329.—Method of examining wax-tipped catheter	127
330.—Gouges on wax-tipped catheter from impact against a ureteral stone	128
331.—Wax-tipped catheter deeply gouged by impact against stone in right kidney	128
332.—Gouged wax-tipped catheter	128
333.—Gouged wax-tipped catheter making positive diagnosis where X-ray pictures had failed to show stone	128
334.—Deeply scratched wax-tipped catheter, due to impact against a stone in left ureter	128
335.—Gouged wax-tipped catheter, from impact against stone in pelvis of right kidney	128
336.—Gouged wax-coated catheter and the stone which caused gouges	129
337.—Gouged wax-tipped catheters	130
338.—Deeply gouged wax-tipped catheter, from impact against stones in pelvis of kidney as well as in ureter	130
339.—Gouged ureteral catheters obtained from catheterizing the two kidneys	130
340.—Gouges in wax-tipped catheter due to stone in right ureter	130
341.—Appearance of calculus which caused scratch-marks shown in Fig. 340	131
342.—Gouged tips of waxed catheters, due to stone in vesical end of right ureter	132
343.—The ureteral stone which scratched catheters shown in preceding figure	133
344.—Shadowgraph of right kidney, showing a large stone	134
345.—Skiagram showing immense stone occupying pelvis and calices of the kidney	135
346.—Large stone in left kidney successfully removed by pyelotomy	140
347.—Hydronephrotic right kidney due to obstruction of the upper ureter by stones	141
348.—Pyelotomy for stone in the pelvis of kidney	142
349.—Suturing of pyelotomy incision after removal of stone	143
350.—Stones filling the lower calyx of kidney	144
351.—Removal of large coral stones from renal pelvis and calices through nephrotomy incision	145
352.—Deeply scratched wax-tipped catheter	146
353.—Length and position of nephrotomy incision in case illustrated in three succeeding figures	146
354.—Fragments of stones removed in the case shown in preceding two figures	147
355.—Kidney removed one year after nephrotomy, for stone	147

LIST OF ILLUSTRATIONS.

xi

FIG.	PAGE
356.—Kidney shown in preceding figure laid open	148
357.—Wax-tipped catheter showing gouges from large stone in pelvis of left kidney	149
358.—Nephrotomy incision in the non-vascular plane used in the case shown in preceding and following figures	149
359.—Large coral stone in right kidney, filling pelvis and calices	150
360.—Case of stones in kidney and ureter, bilateral renal tuberculosis and tuberculosis of the bladder	151
361.—Shriveled kidney surrounded by fat which on palpation simulated a normal kidney	152
362.—Extraction of stone in the ureter by means of stone forceps, introduced through incision in manner shown	154
363.—Diagram of the right kidney and ureter—stone in ureter at pelvic brim; incision made to remove stone	154
364.—Extra-peritoneal exposure of portion of ureter containing stone, shown in last figure	155
365.—Incision and removal of stone below the stricture	156
366.—Calculus in lower ureter, causing hydro-ureter	156
367.—Ureteral calculus lodged in vesical end of ureter	157
368.—Combined abdominal and vaginal incisions to remove stone shown in Fig. 367	158
369.—Stones removed from ureter in case shown in preceding figure, also Fig. 325	159
370.—Gouged wax-tipped catheter due to passage over stone in right ureter	159
371.—Transvesical removal of stones from vesical end of ureter, through vesico-vaginal incision	160
372.—View of bladder and uterus in the knee-chest posture, showing opening in trigonum as pictured in last figure	161
373.—Stones removed at operation and passed subsequent to operation, in case illustrated by two preceding figures	162
374.—Piece of rubber dropped through suprapubic opening into bladder and remaining there three weeks	165
375.—Hairpin calculus	166
376.—Hairpin calculus	167
377.—Incrustation about rubber tube	168
378.—Vesical calculus	169
379.—Section of a large stone removed from the bladder of an eight-year-old girl	170
380.—Eight pyramidal stones of almost identical size and shape	171
381.—Transverse section of one of the pyramidal stones shown in last figure	171
382.—Removal of stone from diverticulum in bladder through open-air cystoscope	172
383.—Skiagraph showing stone in vesical diverticulum	173
384.—Demonstration of small stone in bladder through open-air cystoscope	174
385.—Open-air speculum view of stone shown in last figure	175
386.—Glass catheter splintered in bladder during labor	175
387.—Bigelow's lithotrite	176
388.—Bigelow's evacuating apparatus	176
389.—Young's combined lithotrite evacuator and cystoscope	178
390.—Enlarged view of Young's lithotrite	179
391.—Vesico-vaginal incision for removal of stones in bladder and lower ureter	180
392.—Removal of stone from bladder through a vesico-vaginal incision	181
393.—Pipe-shaped articulated calculi lying in a urethral diverticulum and extending into the urethra	184
394.—Sediment from echinococcus cyst	190
395.—Characteristic group of eggs of the Bilharzia hematobia	193
396.—Schistosoma hematobium	194

FIG.	PAGE
397.—Portion of bladder viewed from interior showing lesions due to <i>Bilharzia hematobia</i>	195
398.—Actinomycosis of the kidney	198
399.—Simultaneous lavage of pelves of both kidneys	208
400.—Multiple infected infarcts of kidney	218
401.—Pyonephrotomy. First step in exposure and evacuation of pus kidney	227
402.—Pyonephrotomy. Second step in enucleation of a large pyonephrotic kidney	228
403.—Pyonephrotomy. Third step in intracapsular enucleation	229
404.—Pyonephrotomy. Fourth step in intracapsular enucleation	230
405.—Carcinoma of the kidney	238
406.—Carcinoma of the kidney	240
407.—Carcinoma of the kidney	242
408.—Sarcoma of kidney	244
409.—Tubular Adenoma of the kidney	246
410.—Papillary cyst-adenoma of the kidney	247
411.—Hypernephroma	248
412.—Hypernephroma	249
413.—Hypernephroma	250
414.—Coronal section through tumor shown in last figure	251
415.—Mesial view of hypernephroma of right kidney	252
416.—Transverse section of tumor shown in last figure	253
417.—Hypernephroma and metastases	254
418.—Variations in structure of different parts of tumor shown in Figure 412	256
419.—Section through edge of tumor shown in Figure 411	258
420.—Section of tumor shown in Figure 411 under slightly greater magnification	259
421.—Another section through tumor shown in Figure 411	259
422.—Papilloma of the renal pelvis	260
423.—Embryonic tumor	263
424.—Embryonic tumor	263
425.—Typical embryonic kidney between third and fourth month	264
426.—Enlargement of previous section, showing glomeruli	264
427.—High magnification of embryonic tumor, showing glands, striated muscle and embryonic tissue	265
428.—Fibro-myxo-sarcoma of right suprarenal gland	266
429.—Section of tumor and growth shown in Figure 428	267
430.—Remarkable case of giantism associated with adrenal tumor	269
431.—Blood cyst of right kidney	273
432.—Cyst of kidney	274
433.—Bilateral congenital cystic kidneys in the adult	277
434.—Coronal section of right kidney of case shown in Figure 433	278
435.—Section of portion of large polycystic kidney	279
436.—Bilateral cystic kidneys in still-born babe	280
437.—View obtained at operation of large hypernephroma	283
438.—Longitudinal section of tumor shown in last figure	285
439.—Method of removing tumor plug from renal vein and vena cava	286
440.—Decapsulation of the kidney for nephritis	294
441.—Rupture of aneurysm between leaves of renal fatty capsule	297
442.—Ruptured aneurysm, as in last figure, in transverse section	298
443.—Operative injury to ureter, in removing large cancerous tumor of ovary	304
444.—Completed uretero-vesical anastomosis	305
445.—Solitary ectopic kidney and pelvic organs seen through a median abdominal incision	308

LIST OF ILLUSTRATIONS.

xiii

FIG.	PAGE
446.—Coronal section of horseshoe kidney shown in next figure	313
447.—Horseshoe kidney with aortic aneurysm	314
448.—Unilateral horseshoe kidney	315
449.—Horseshoe kidney of remarkable type	316
450.—Horseshoe kidney of remarkable type	317
451.—Unilateral horseshoe kidney	318
452.—Two cases of sigmoid kidney	319
453.—Lump kidney (so-called)	321
454.—Ectopic kidney on left side, with a normal right kidney	322
455.—Ectopic left kidney with abnormal internal generative organs	323
456.—An unusual abdominal tumor shaped like a kidney situated in the middle line	324
457.—Section of tumor shown in previous figure	325
458.—Division of renal pelvis into upper and lower branches	326
459.—Diagrams from actual cases, showing anomalies of ureters and renal pelvis	328
460.—Diagrams illustrating the origin of a divided renal pelvis as compared with that of a single pelvis	330
461.—Four diagrams illustrating the development of a kidney with divided pelvis and double ureter	332
462.—Actual case of double pelvis and double ureter, representing the most usual type	335
463.—Kidney with double ureter and two openings into bladder	336
464.—Speculum views of urethral orifice of ureter	340
465.—Sagittal view of method for treating dilated anomalous ureter opening into urethra	341
466.—Determination of distance of stricture of ureter from vesical orifice	350
467.—Series of catheters of bougies used to dilate stricture of the ureter	353
468.—Measuring the force needed to withdraw a renal catheter held in the bite of a strictured ureter	354
469.—Uretero-vesical anastomosis	355
470.—End-to-end anastomosis of cut ureter	356
471.—Prolapse of right ureter into bladder, forming a cyst	357
472.—Prolapse of vesical end of ureters into bladder, due to stricture induced by cystitis	358
473.—Distended bladder and its topography in relation to peritoneum, intestines, and pelvic bones	362
474.—Anterior view of distended hardened bladder	363
475.—Section of the bladder showing general disposition of coats	364
476.—Relations of urethra and trigonum of bladder as seen from vaginal side	365
477.—Musculature of the bladder and urethra	366
478.—The arterial circulation of the bladder and urethra as seen from the side	368
479.—The arterial circulation of the bladder as seen from in front and above	369
480.—Urethra showing pronounced labia	370
481.—Loculate bladder	374
482.—Diverticulum of the bladder	376
483.—Demonstration of diverticulum by introduction of catheter	378
484.—Method of treating diverticula through open-air cystoscope	380
485.—Papilloma in diverticulum	381
486.—Diverticulum closed; sphincteric action of the orifice	381
487.—Diverticula of the urinary bladder with special reference to Röntgen-ray diagnosis	382
488.—Radiograph of diverticulum and bladder taken from the left side	383
489.—Eversion of bladder	385
490.—Exstrophy of the bladder in girl with prolapse of the rectum	386
491.—Exstrophy of bladder in adult female	387

FIG.	PAGE
492.—Extensive cancer of exstrophied bladder	388
493.—Operation for exstrophy of the bladder in male subject	392
494.—Suturing of freed bladder, as shown in last figure	393
495.—The last step in the operation shown in two preceding figures	394
496.—Sonnenberg's method of treatment of exstrophy	395
497.—G. R. Fowler's case of epispadias	397
498.—G. R. Fowler's case of epispadias	398
499.—Fistula between small intestine and bladder	405
500.—Adherent bladder and bowel shown in last figure separated	406
501.—Exposure of a difficult vesico-vaginal fistula, following hysterectomy	408
502.—Sagittal view of vesico-vaginal fistula, with open-air speculum in urethra	410
503.—Exposure of small vesico-vaginal fistula	411
504.—Sponge on clamp introduced into bladder through fistula as aid in denudation	412
505.—Sickle-shaped knife—sharp on both sides	413
506.—Delicate scissors curved on the flat, for paring edges of vesico-vaginal fistula	413
507.—Immense vesico-vaginal fistula, involving entire trigonum, including sphincter area	414
508.—Fistula shown in last figure, with sutures tied	415
509.—Paring edges of vesicovaginal fistula preparatory to closure	416
510.—Closure of vesico-vaginal fistula	416
511.—Closure of a vesico-vaginal fistula with sutures placed in antero-posterior direction, making a transverse line when tied	417
512.—Closure of vesico-vaginal fistula, as in last figure, with a separate layer of sutures for the bladder	417
513.—Three styles of self-retaining catheter	418
514.—Vesico-cervico-vaginal fistula	418
515.—Vesico-cervico-vaginal fistula	418
516.—Vesico-cervico-vaginal fistula	419
517.—Closure of vesico-uterine fistula, from below	419
518.—Vesico-uterine fistula	420
519.—Vesico-uterine fistula treated through median abdominal incision	420
520.—Treatment of vesico-uterine fistula by abdominal incision	421
521.—Vesico-uterine fistula closed by operation from above	422
522.—Large fistula with rigid vaginal walls	424
523.—Dudley's operation for large vesico-vaginal fistula with rigid edges	425
524.—Dudley's operation completed	425
525.—Double vesico-vaginal fistula, I	426
526.—Double vesico-vaginal fistula, II	427
527.—Double vesico-vaginal fistula, III	428
528.—Vesico-vaginal fistula near vault of vagina rigidly fixed by dense scar tissue	429
529.—Treatment of fistula pictured in last figure through a median abdominal incision	429
530.—Completed operation illustrated in two preceding figures	430
531.—Vesico-vaginal fistula with pelvic inflammation, I	430
532.—Vesico-vaginal fistula with pelvic inflammation, II	431
533.—Vesico-vaginal fistula with pelvic inflammation, III	432
534.—Uretero-vaginal fistula	432
535.—Urethro-vaginal and recto-vaginal fistula at the same level	433
536.—Urethro-vaginal and recto-vaginal fistula	434
537.—Sagittal view of end of ureter, bladder and vagina in case of double uretero-vaginal fistula	436
538.—Completion of operation seen in last figure	437

LIST OF ILLUSTRATIONS.

XV

FIG.	PAGE
539.—Uretero-vaginal fistula, I	438
540.—Uretero-vaginal fistula, II	439
541.—Uretero-vaginal fistula, III	440
542.—Another method of treating uretero-vaginal fistula	441
543.—Section through part of bladder wall, showing changes in acute cystitis	446
544.—Schematic representation of down-dipping of epithelium simulating gland structure	447
545.—Extensive pseudo-gland formation in a case of chronic cystitis cystica	448
546.—Extensive calcareous deposits in bladder in case of chronic cystitis	449
547.—Calcareous deposits on bladder wall	450
548.—Inspecting and plotting out a focus of disease in bladder with open-air cystoscope	451
549.—Ulcers on trigonum	453
550.—Calcareous deposits surrounded by marked injection of bladder	453
551.—Linear healing ulcer on posterior bladder wall, as seen through cystoscope	454
552.—Enormous hypertrophy with edema of anterior vaginal wall simulating cystocele	455
553.—Irrigation of bladder through two-way catheter	460
554.—One method of irrigating bladder by means of two-way catheter	461
555.—Dickinson's two-way catheter	462
556.—Chart showing progress under distention treatments	464
557.—Operative formation of vesico-vaginal fistula	467
558.—Completion of operation shown in last figure	468
559.—Hunner's plan of continuous irrigation of bladder with patient in a tub	469
560.—Continuous irrigation of the bladder with patient in bed on bed-pan	470
561.—Large solitary ulcer of bladder, as seen through suprapubic opening	471
562.—Suprapubic excision of ulcer of bladder	472
563.—Second step in operation shown in last figure	473
564.—Third step in excision of ulcer from bladder	474
565.—The last step in excision of ulcer of bladder	474
566.—Sequestration of bladder to insure against peritonitis after a suprapubic operation	475
567.—Sequestration of bladder, as seen from front	475
568.—Sequestration of bladder in male by suturing omentum to its posterior surface	476
569.—Alligator scissors	477
570.—Simple papilloma	508
571.—Papillomatous tumor of bladder showing tips of papillæ and finger-like prolongations	509
572.—An apparently simple papilloma with a base almost as broad as the tumor is high	510
573.—Section from another part of the same tumor as in Fig. 572	511
574.—Papillary adenocarcinoma, which, to the naked eye, appears to be a simple papilloma	512
575.—High magnification of tumor shown in Fig. 574	513
576.—Section in deeper part of tumor (adeno-carcinoma), shown in two preceding figures	514
577.—Squamous-celled carcinoma developing in a case of exstrophy of the bladder	515
578.—Carcinoma of the bladder	516
579.—Higher magnification of tissues at the base of tumor shown in preceding figure, showing carcinomatous invasion of the muscle	517
580.—Carcinoma springing from retro-symphyseal wall of bladder	518
581.—Carcinoma of ureter, secondary to primary growth in prostate gland and bladder	519
582.—Sagittal view showing carcinoma which has developed in diverticulum of posterior wall of bladder	520
583.—Thompson's case of dermoid tumor removed from bladder	521
584.—Mucous polyps (myxosarcoma) in a girl	523

FIG.	PAGE
585.—Large myomatous vesical tumor arising from entire top of bladder and filling viscus	524
586.—Rhabdo-myosarcoma in a child	527
587.—Rhabdo-myosarcoma in a child	528
588.—Pedunculate papilloma situated just in front of right ureteral orifice	530
589.—X-ray picture of bladder injected with bismuth subnitrate suspended in water	531
590.—X-ray picture of large papilloma attached to right base of bladder between urethra and ureter	532
591.—Demonstration of method of fulguration through air distention cystoscope	535
592.—Destruction of pedicle of artificial tumor by direct application of electrodes on opposite sides (D'Arsonval current)	536
593.—Cooking off the pedicle of an artificial tumor	537
594.—Exposure of bladder by means of transverse incision above symphysis	538
595.—Exposure of bladder by means of transverse incision above symphysis	539
596.—Exposure of bladder by transverse incision above symphysis	540
597.—Exposure of bladder by transverse incision above symphysis	541
598.—Air distention of bladder by means of rubber catheter, attached on the outside to a bulb, in the operation of suprapubic cystotomy	542
599.—The succeeding step in suprapubic opening of bladder	543
600.—Next step in suprapubic removal of papilloma of bladder	543
601.—Next step in operation shown in two preceding figures	543
602.—Final step in operation shown in preceding figures	544
603.—Exposure of pedunculate papilloma near right ureteral orifice through suprapubic incision	545
604.—Removal of papilloma shown in last figure by clamp and cautery method	545
605.—Appearance of bladder at close of operation pictured in preceding drawings	546
606.—Completion of suprapubic operation for removal of vesical tumor	546
607.—Completion of suprapubic operation for removal of vesical tumor	547
608.—Closure of transperitoneal opening in bladder, I	548
609.—Closure of transperitoneal opening into bladder, II	549
610.—Durand's classification of the various forms of epispadias	566
611.—Frommel's case of epispadias in a woman 26 years of age	569
612.—Stiles' method of implantation of the ureter in epispadias	570
613.—A high grade of hypertrophied and prolapsed urethral mucous membrane	575
614.—Sagittal view of condition shown in last figure	575
615.—Prolapsed and strangulated urethral mucous membrane	576
616.—Appearance after circular amputation of prolapsed and hypertrophied urethral mucous membrane shown in Figures 613 and 614	577
617.—Urethral speculum, identical in shape with vesical speculum but much shorter	580
618.—Hegar dilators	581
619.—Improvised syringe for carrying medicaments up the ducts of Skene's glands	582
620.—Abscess of gonorrheal origin in Skene's gland to the left of the urethra	583
621.—Large suburethral abscess	584
622.—Typical urethral caruncle, springing from right posterior margin of urethra	589
623.—Urethral caruncle	590
624.—Mucous polypi of urethra and sphincter region of bladder	592
625.—Primary squamous carcinoma of urethra	594
626.—Ehrendorfer's case of carcinoma of vestibule completely surrounding and involving urethral orifice	595
627.—Adenocarcinoma of urethra secondary to adenocarcinoma of body of uterus	596
628.—Beigel's case of sarcoma of urethra	598

DISEASES OF THE KIDNEYS, URETERS AND BLADDER.

VOLUME II.

CHAPTER XVIII.

ESSENTIAL HEMATURIA AND NEPHRALGIA.

Under the various names, idiopathic renal neuralgia, idiopathic renal hematuria, bleeding from healthy kidneys, renal epistaxis, essential hematuria, angio-neurotic bleeding kidney, a characteristic and interesting group of cases has been described. Although it has long been known that bleeding may occur from an apparently healthy kidney and Rayer has discussed the subject in his "Traité des maladies des reins," 1851, it was Sabatier who opened up the subject in 1889 (*Rev. de chir.*, 1889, ix, 62) with the report of a case of what he called "nephralgie hematurique." His patient, a woman thirty years old, had an association of hematuria and colic in the right kidney, which led him to suspect stone in the kidney. He operated, found a normal-looking kidney, and did a nephrectomy. Careful microscopical study of the kidney which he removed showed no alteration in structure, save a slight, chronic interstitial nephritis. Reports of other cases have followed rapidly. Our first two cases were published by Dr. Albert Staveley in March, 1893 (*Johns Hop. Hosp. Bull.*, 1893, iv, 25). The first had the association of an intermittent hematuria and renal colic. The second had no colic, and the bleeding had been present continuously for a year and a half. In both cases the kidneys looked normal macroscopically, and a small piece of tissue removed from the cortex of each showed no disease. Several of these cases present themselves every year. Up to a few years ago we had had some 24 cases, and as they have been under observation long enough to judge of therapeutic results, we have based this chapter upon them and give abstracts of them at its close. We have included in this group cases where there has been an association of hematuria and nephralgia, and those in which there has been simply hematuria, and a

few in which nephralgia was the dominant symptom. In only two of the entire list of operated cases did the urinary findings suggest nephritis, and this was confirmed by a pathologic examination of small pieces of cortex removed at the time of the operation. In all the other cases where bits of kidney were removed the organs appeared normal.

ETIOLOGY AND PATHOLOGY.

There has been much contention as to the pathologic lesions leading to this condition. Many authors assert that almost without exception the underlying cause is the nephritis. Israel, on the basis of a large experience, is inclined to believe all cases due to this cause, and makes the following points:

First, a nephritis can be one-sided.

Second, nephritis of one side can give colic and hemorrhage.

Third, a double-sided nephritis can give colic in one side only.

Fourth, severe nephritis can be present without either casts or albumin occurring in the urine.

Albarran makes the following points in a publication in *La Presse méd.*, 1904, 657:

A clear difference exists between nephritides. In some the nephritis involves the entire kidney equally, and in some it is focal and limited to parts of the kidney. He quotes a case where Necholich, after a pathological examination, pronounced a kidney normal, and yet Motz, examining it later, found a patch of nephritis.

E. Lewitt (*Monatsb. f. Urol.*, 1904, ix, 347) reports three cases operated on by Casper with one-sided hemorrhage, yet double-sided nephritis.

R. Stich (*Mittheil. a. d. Grenzgeb. d. Med. u. Chir.*, 1904, xiii, 781) reports a case of hemorrhage from one kidney in which an autopsy showed a nephritis located in this kidney alone, the other being normal.

These conflicting views are often of more academic than practical interest, since there is great difficulty in getting a small piece of focal nephritis separated in a kidney which has been removed. The facts are that there are many cases on record of hemorrhage from a kidney, where neither the previous nor subsequent histories suggested nephritis, where at operation no disease could be seen macroscopically, and where the microscopic examination of a small piece of cortex indicated a normal kidney.

Several cases are on record where nephrectomy has been done, and under

most careful microscopical examination of the removed kidney nothing has been found. Klemperer, Schede, and others have reported such cases.

Recently Dr. J. W. Keefe reported such a case (*Am. J. Urol.*, 1907, iii, 60). It was the case of a man of 36. There was hemorrhage from the left kidney, and thickening of the testicle. The removed kidney was carefully examined by Dr. F. Fulton and reported to be normal. H. A. Fowler (*Am. J. Urol.*, 1912, viii, 249) reports a case in which he did a nephrectomy for very severe hemorrhage and in which the pathological examination failed to show any sufficient cause for the bleeding. Benjamin S. Barringer (*Am. J. Urol.*, 1912, viii, 229) collected 73 cases out of the literature, in 26 of which nephrectomy was done, and while 3 of the 26 kidneys removed were apparently normal, the others showed various degrees of nephritis. In 7 cases out of the 73 the focus of bleeding was located in the pelvis. Alexander Randall of Philadelphia (*J. Am. Med. Assoc.*, 1913, lx, 10) considers the causes, in order of frequency, to be nephritis, varices of the pelvis and rupture of blood vessels. A most interesting group of cases is that in which hematuria is associated with appendicitis, and relieved by removal. V. Frisch (*Ztschr. f. Urol.*, 1912, vi, 245) and E. DuVal (*Normandie méd.*, 1912, xxvii, 244). To our associate, Dr. G. L. Hunner (*J. Am. Med. Assoc.*, 1908, i, 1328), belongs the credit of first drawing attention to this condition. The patient in whom he observed it was 38 years old and for several years had been having attacks of pain in the right side, associated with throbbing pain in the rectum and accompanied by blood in the urine from the right kidney.

We have never had occasion to remove a kidney for this form of bleeding, but in the cases where we have removed small pieces of tissue and there has been no evidence of nephritis in the urine there has not been the slightest on microscopic examination. In two cases where there were albumin and casts before operation these persisted after operation, and the pieces of tissue removed showed definite nephritis.

Various views have been advanced as to the cause of pain in these cases. Lennander (*Mitth. a. d. Grengb. d. Med. u. Chir.*, 1902, x, 164), thinking especially of cases of acute nephritis where associated with oliguria with marked pain and sensitiveness over the kidneys, considers that the pain is due to a pressure within the capsule, and points to the relief of decapsulation. Senator (*Berl. klin. Wchnschr.*, 1895, xxxii, 277) holds that the colic is not due to any tension, but to malpositions and adhesions. Israel (*Mitth. a. d. Grengb. d. Med. u. Chir.*, 1889, v, 471) supports the view of Lennander. Israel and Albarran have reported cases of nephralgia and hematuria due to ureteritis. A careful review of our own experience leads us to believe that

under this head several different conditions are probably grouped. The cases of bleeding alone, without any pain or without colic, belong to a different group from those in which the two conditions are associated.

Out of our group of 24 cases 6 were of this kind (2, 3, 4, 9, 14, 15). Of the cases with hemorrhage and nephralgia there are 12 (1, 5, 6, 7, 8, 10, 11, 12, 13, 16, 20, 23). Cases with nephralgia alone are 6 (17, 18, 19, 21, 22, and 24). In none of these cases where operation was done, has any cause been discovered for the hemorrhage or pain. Nevertheless, every case operated upon, except one, case 22, was relieved by the operation. The operations performed were nephrotomy, 9 times, in cases 1, 3, 4, 5, 6, 7, 8, 17, 22; decapsulation once, case 23; suspension of the kidney three times (cases 19, 21, and 22); exploration of the ureter twice (cases 18 and 20). There was no displacement of the kidney and no adhesions about it to account for the pain except in case 23, where decapsulation was carried out with perfect result. The cases which were relieved by exploration of the ureter did not show any signs of ureteritis. The reason for the exploration of the ureter in place of the nephrotomy was that the pain complained of was lower down and apparently from the ureter more than the kidney.

We have never had a case attributable to tabes or hysteria. Cases belonging to this group should be looked upon with skepticism. Albarran quotes it as an occasional cause of hematuria and cites the case of Le Tour, where a hysterical woman had had attacks of bleeding in the urine for years whenever she was advised of the infidelity of her husband, and at no other times. Some years ago in the gynecological clinic at the Johns Hopkins Hospital we had a young colored woman twenty years of age who was very hysterical, who had to be catheterized frequently on account of inability to empty the bladder, and who presented at times very bloody urine, and at others perfectly clear urine. The conditions were a source of great speculation among the internes at the hospital, and it was only after weeks that it was discovered that the patient was putting the blood in the urine in order to deceive. It was a case of malingery to secure a living in the hospital, where she had nothing to do and careful nursing and feeding, whereas when she went out it was necessary for her to work.

One of our cases (16) had the bleeding and pain in association with pregnancy. In this case the symptoms disappeared on keeping the patient in bed for a week or two. This patient belongs to the class of cases due to pregnancy and lactation, which were first described by Guyon and Albarran. Broca (*Ann. d. mal. d. org. génito-urin.*, 1894, xii, 881) reports a case of a woman acting as a nurse who, during lactation, developed a marked hematuria after

ceasing to nurse. Albarran supposes that these cases are due to an intoxication. It is possible that the congestion due to pressure on the ureters during pregnancy may have something to do with the condition. In October, 1902, we had a patient four months pregnant who began having pain in the left kidney and blood in the urine about the seventh week of the pregnancy. This condition developed into a marked pyelitis, and it was for the pyelitis that she came for treatment (see Gynecological No. 9,982). According to Guyon, all these cases clear up with the cessation of the pregnancy or the lactation. Hector Treub (*Monatschr. f. Geburt. u. Gyn.*, 1912, xxxvi, 28) reports a case of unilateral hematuria due to pregnancy, and relieved, after futile attempts, in other directions, by interruption of the pregnancy. He has collected 18 similar cases from literature. It is interesting to know that out of a total of 24 cases, 22 in women and 2 in men, no less than 18 of the women were married and had had children. Cases 15, 20, 21, and 24 were in unmarried women. Case 15 was a simple hematuria relieved by injecting adrenalin (Dr. W. W. Russell); case 20 and case 21 were patients where the exploration of the ureter relieved the conditions; and case 24 was one of definite nephritis. This tremendous preponderance in parous women is striking when one considers that we have in general as many non-parous as parous cases. In both of the cases in men there was evidence of nephritic change. In looking over Israel's cases we find that he had six men, seven married women, and one unmarried woman; the latter had passed through a severe infectious disease. In one of our cases the trouble began after an attack of grippe. In another there had been a definite stone passed at one time.

CLINICAL SYMPTOMS.

We have already gone into the principal symptoms, which are blood in the urine, alone, or blood and pain in the kidney, or pain in the kidney. In the cases where blood alone is present, if it is in moderate quantities the patient may have little or no discomfort. In some cases, as in case 2 of this series, the bleeding has kept up for almost 8 years, almost without cessation, and yet the woman is in fair condition and able to work actively. In other cases the hemorrhage may be severe and lead to marked anemia, the hemoglobin being as low as 45 per cent. in case 1, and 27 per cent. in case 15. As pointed out in Chapter VII, page 224, several cases of fatal hemorrhage in Bright's disease have been noted. As a general rule, however, the bleeding is not so great as to result in any serious impairment of health, and the most frequent note made

on the general condition has been, "the patient seems fairly strong and healthy-looking."

The pain which is present in so many of these cases is in the form of attacks of colic resembling in every way that due to stone in the kidney and ureter. In most of the cases the pain has been in the back and radiates toward the bladder. In two cases the pain was in the ureter. As already pointed out, the hemorrhage may be either intermittent or continuous. There is rarely any disturbance from the bladder. Only one patient presented this symptom.

DIAGNOSIS.

Before making a diagnosis of idiopathic renal hematuria, every other cause of bleeding from the kidney must be excluded. This is often a difficult undertaking and must be carried out with great care and thoroughness. All the kinds of hematuria described under Chapter VII should be thought of. One should be sure that there is neither poisoning nor infectious diseases and that the coagulability of the blood is normal. The presence of other elements than blood in the urine is of great importance. Pus and bacteria will indicate infectious diseases; large numbers of casts and albumin, true nephritis. A stone should be found, if present, either by the wax-tipped catheter or the X-ray plate. Tuberculosis should be excluded by giving tuberculin in addition to examination for the organism in the urine. In case of renal tumor valuable aid is obtained by comparing the functional activity of the two sides. In essential hematuria the bleeding kidney is as active as the other one, whereas in case of neoplasm it is much more likely to be reduced in its function. Endocarditis should suggest an infarct. In all cases the careful clinical history is of great importance. In the essential hematuria and nephralgia there is no general disturbance; the temperature and pulse are normal. In spite of all effort, however, some cases will remain in doubt. A small tumor of the kidney or its pelvis or an aneurism might cause identical symptoms and physical manifestations.

TREATMENT.

After a diagnosis has been reached, it is justifiable to try an expectant and a medicinal treatment, providing the hemorrhage *per se* is not so great as to endanger the patient's life. In none of our cases have we had the misfortune to have the condition subsequently proved to be neoplasm. The results

of the expectant treatment, however, are not nearly so brilliant as of the operative. Out of ten cases treated medicinally, five were relieved, two relieved only after long periods in bed, and three not relieved. The patient should be put to bed and kept on a milk diet. In this way many cases of hemorrhage can be checked. In cases 12, 14, and 24 treatment of this kind was sufficient to check hemorrhage, which had persisted for months. In case 16, where there was a pregnancy, it was likewise successful. Various styptics may be given in full doses by mouth. M. Freund (*Centralbl. f. d. Harn- u. Sex.-Org.*, 1906, xvii, 204) recommends stypticin in full doses. Cases are on record where ergot has proved of value. Molnov reports the use of adrenalin by mouth, in 20-minim doses every four hours. Personally we have not seen very brilliant results from such drugs. In case 15 our associate, Dr. Russell, injected 15 c. c. of a 10 per cent. adrenalin solution with complete cure. Dr. Hugh Young of Baltimore recently reported a successful case of this kind. In Young's case there was a recurrence of the hemorrhage in the fall of the year, but it persisted only a few days and then ceased. We think it quite likely that cases relieved in this way are due to some small varix in the pelvis of the kidney. Neither Russell's nor Young's case was associated with colic. In a number of cases where we have tried adrenalin personally it has failed. With such marked results in other cases, however, it is a method that should be carried out in every case. Albarran (14th *Internat. Congress of Med.*, Madrid, 1903) reported a case in 1903 where, as the result of a cystoscopic examination, the hemorrhage ceased. He quotes a case of Picqué and Reblaub (*Rev. de chir.*, 1895, xv, 927), who diagnosed that the hemorrhage came from the bladder and did a suprapubic cystostomy, only to find that the bleeding was coming from one kidney. The patient was sent back to bed and an operation on the kidney planned for the next day. The bleeding, which had been long continued, stopped spontaneously, and no other operation was necessary. In one of our own cases the hemorrhage, as well as the colic, ceased for about three months after catheterizing the ureter (see case 13). When, in spite of these medicinal measures, the trouble still continues, an exploratory operation should be performed.

The kidney is reached by the usual lumbar incision and should be delivered through the incision. If it is found to be normal-looking it should be opened up in the plane of vascular cleavage by means of the silver wire method. The pelvis, calices, and apices of the pyramids can by this means be explored. The kidney should then be sewn together if no disease is found, and the incision closed, with the exception of a small drain down to the kidney. The results of this procedure are most excellent. We have employed it in

nine cases. In two cases the hemorrhage did not cease at once, but was greatly decreased and ultimately ceased. The pain was relieved in all except one (case 22). Out of eleven cases Israel reports six relieved by nephrotomy, three temporarily relieved, and two not benefited.

We have never found it necessary to leave the kidney open and let it heal by granulation, as suggested by Israel. Durham reports a case which continued to bleed for two years after his nephrotomy. The condition was relieved by a nephrectomy. When the hemorrhage is of small amount and the pain marked and low down, suggesting a ureteral stone, we would advise an exploration of the ureter through a muscle-splitting incision. This can readily be explored all the way from the kidney pelvis to the bladder. We did this operation in cases 18 and 20 with complete relief of the symptoms. It is possible to palpate the kidney through the incision made to explore the ureter. The nephrotomy is effectual when there is actual nephritis present, as shown by the presence of casts and albumin, as is evidenced in case 6 of our list. Edebohls (*Med. Record*, 1901, ix, 961) had secured a complete cure in the same kind of a case by decapsulation. In case 23 of our series decapsulation was performed with perfect relief. This patient did not have an ordinary form of nephritis, but there were adhesions between the fatty and the fibrous capsules. Harrison (*Brit. Med. Jour.*, 1901, ii, 1,125) reports three cases successfully treated by renipuncture. Nephrectomy, which was carried out in a number of the early cases, should never be done unless all other methods have failed and the patient continues to bleed to such an extent that life is in jeopardy. This must be a very rare condition.

ILLUSTRATIVE CASES.

Case 1.—Gynecological Number 11,393. Mrs. H. P. Age 37. White. Admitted July 7, 1904. Discharged August 1, 1904. Complaints: attacks of colic in right kidney, associated with hematuria of moderate degree.

The family history was negative. The past history was that patient had always been delicate, no definite disease of any kind. She was the mother of seven children. The youngest child five years old. Present illness, the patient had suffered from attacks of pain in the right side for five years, the attacks being frequently associated with small amounts of blood in the urine. The attacks of pain began in the kidney and radiated down toward the bladder. The attacks came every week or two and would last for an entire day. The patient had acquired the morphia habit. The general physical examination showed

a stout but well-nourished woman. No evidence of disease made out in the heart or lungs, temperature and pulse being normal; 78 per cent. of hemoglobin; the leukocyte count 6,000. Neither kidney was palpable; the pelvic organs were normal; the urine, except for an occasional blood cell, was normal. A wax-tipped catheter was passed into the right ureter up to the kidney, but no scratch mark was obtained. The X-ray picture also showed nothing. The right kidney was injected with sterile salt solution and its capacity found to be 8 c. c. A typical attack of the pain from which she was suffering was thus brought on.

Operation: July 3, 1904. The right kidney was explored through a typical lumbar incision. It was normal in shape and appearance. It was opened in the plane of vascular cleavage in the long axis. No alteration of any kind was found. The kidney was sewn up with catgut sutures.

Results: Except for a slight temperature after the operation for a few days there was no complication following this operation. The patient ceased having pain and has had none since then. Several careful examinations of the urine made three years later showed that it was perfectly normal.

Case 2.—Mrs. N. G. Gynecological Number 9,370. Age 37. White. Admitted January 28, 1902; discharged February 2, 1902.

The family and past history are entirely negative in this case. The patient had had no pain of any kind, but stated that she had been having blood in the urine for $2\frac{1}{2}$ months. The general physical examination showed a fairly healthy-looking woman. Hemoglobin 78 per cent.

Neither kidney was palpable. The pelvic organs were normal. The urine showed blood, but no casts or other abnormal elements. Cystoscopic examination showed a normal bladder and bloody urine from right kidney. The amount of urine from the two kidneys was equal. This patient declined an operation. She was seen five and a half years later, in 1907, and reported that, with the exception of two intervals of about three weeks each, blood continued to be present in the urine at all times. That the amount of blood varied greatly. At times there were small clots. There had been no pain of any kind. She had been hard at work. Cystoscopic examination made on June 20, 1907, showed that the bladder was normal, that both ureteral orifices were normal. Both kidneys were catheterized, the lengths of the ureters were equal, 26 cm. in each case; the right kidney was secreting a urine made red by blood while the left side was secreting normal, clear urine. In ten minutes the left kidney secreted 6 c. c. of urine and the right $6\frac{1}{2}$. The polyuria test showed that both kidneys were equally active. The amount of urea was identical on the two sides.

Case 3.—Mrs. L. S. Gynecological Number 1,371. Age 37. White. Admitted June 5, 1892; discharged July 22, 1892.

The family history was negative. Had been married 17 years. Several children. Had never had any acute illnesses of any kind. The present trouble began two months after the birth of her last child, five years ago, when she for the first time noticed blood in the urine. This blood was only present for one day. It did not return again for six months. It, however, gradually became more frequent, coming every week or two, and for the past five weeks the urine had been continuously bloody. Patient had never had any pain whatever in either kidneys or bladder. Physical examination showed a well-nourished woman, the heart, lungs, and the abdominal organs were normal on examination. She was quite anemic. Hemoglobin 45 per cent. Temperature and the pulse were normal. The urine was normal except for the presence of blood. The urine was examined for some days without ever finding a cast. Cystoscopic examination showed a normal bladder and at first bleeding from both kidneys. Repeated examinations, however, disclosed the fact that the bleeding was almost entirely from the right kidney. On July 2, 1892, the right kidney was explored. It was apparently normal in every way. It was opened in the plane of vascular cleavage longitudinally and the pelvis also explored. Kidney was sewn up. The patient made an uninterrupted convalescence, and went out of the hospital without any hemorrhage. The urine at that time was perfectly normal. Results: For three years after the operation, at intervals of several months, the patient had hemorrhages lasting a day or two, but in the twelve years following the first four years there was no return of hemorrhage, so that this patient, we know, has been perfectly well for about fourteen years.

Case 4.—Mrs. Z. G. Gynecological Number 1,654. Age 36. White. Admitted November 1, 1892; discharged November 29, 1892.

The family and past history were entirely negative. The menstrual history was negative. The patient had had one child, nine years ago. The patient had been having blood in the urine for about a year. At times it was absent for a day or two; was never very great in quantity. The general condition of this patient was excellent. There was no evidence of disease outside of the urinary tract. The urine was normal except for the blood. The bladder on cystoscopic examination was found to be normal. On catheterizing the ureter both kidneys were found to be functioning, but the bleeding was entirely from the left side. On October 9, 1892, operation was performed; left kidney was found perfectly normal-looking. Its pelvis was found to be normal-looking. A small piece of tissue removed at the time of operation proved to be normal.

The kidney was drained. Result: The patient ceased having hemorrhage, and for two years was perfectly well. She has been lost sight of since that time.

Case 5.—Mrs. H. C. Gynecological Number 11,282. Age 37. White. Admitted May 16, 1904; discharged June 18, 1904.

The patient gave a family history of tuberculosis, but has always been well and strong herself. She had four normal pregnancies. She dated present illness to an attack of renal colic nine years before she came to the hospital. She had frequency of menstruation at that time and passed a stone by the urethra. Three years later she passed another stone. From that time onward there was no trouble until three months earlier, when a dull pain began in the left loin. Physical examination showed a healthy-looking woman. Temperature normal. Heart and lung examination normal. Neither kidney enlarged or tender. Neither kidney palpable. On cystoscopic examination bladder found normal. The bloody urine was found to be coming entirely from the left kidney. Both ureters were catheterized. The right kidney was found to be secreting in 8 minutes 6.4 c. c. of urine with a percentage of urea of .005. In the same time the left kidney secreted 4.3 c. c. with a percentage of urea of .003. The wax-tipped catheter showed no scratch marks. The X-ray also was negative. The urine contained no abnormal elements except blood. It would seem from the urine examination here that the left kidney was really better than the right. Unfortunately no subsequent studies were made. The operation was carried out on May 28, 1904. On cutting down on the kidney a perfectly healthy organ was found so far as external appearance was concerned. Longitudinal nephrotomy was done. Macroscopically the kidney parenchyma and pelvis looked normal.

A small piece of tissue removed from the kidney proved on microscopical examination to be normal. Results: This patient made an uninterrupted convalescence and has remained for six years without any recurrence whatsoever of the hemorrhage. She has had a child in the interval without any bad effect.

Case 6.—Mrs. N. B., Gynecological Number 13,605. Age 60. Date of admission February 18, 1907.

The family history showed marked tuberculosis, but the patient had always been a healthy woman herself until about six years before, when, after an attack of la grippe, she had an attack of pain in the right kidney region, lasting for two hours, followed by the appearance of blood in the urine. At intervals since then patient had had recurrence of attacks of hematuria lasting from one to three days, sometimes without pain and sometimes associated with colic. Once or twice there had been severe attacks of pain. The patient in this case

was a healthy-looking woman for her age. The heart and arteries were normal. There was no fever. On palpation both kidneys were tender and enlarged. The bladder on cystoscopic examination was normal. Both kidneys were catheterized. From both kidneys urine containing albumin, hyalin, and granular casts was obtained. The urine from the left kidney was clear; that in the right bloody. Functional tests from the two sides showed about equal secretory function from the two kidneys. Operation was carried out by the usual lumbar incision. Rather large red kidney was found. Typical nephrotomy done. A piece of kidney removed for microscopical examination showed marked interstitial nephritis and proliferative glomerulitis. The patient made an uninterrupted convalescence and the blood immediately ceased appearing in the urine. It has recurred, however, in small quantities since that time.

Case 7.—Mrs. J. C., Gynecological Number 9,923. Age 46. Admitted October 30, 1902. Discharged January 7, 1903.

The family history was negative. The menstrual history negative. The patient had had four children, the youngest eight years old. She had had no illnesses of any kind. Her trouble started six months before coming to the hospital, with slight attacks of pain, small amounts of blood in the urine. Since beginning the bleeding had been continuous, but the pain only came in attacks. It consisted in a slight attack of pain in the left kidney region. The general condition of this patient was rather poor. Temperature and pulse were normal. Hemoglobin 65 per cent. Neither kidney was enlarged or tender, and neither movable. The X-ray was negative. The tubercular reaction was also negative. Both ureters were catheterized. The urine from the left side was quite bloody. That from the right side normal. The operation was performed on November 12, 1902, by the usual lumbar route. A perfectly normal-looking kidney found. Our usual nephrotomy was performed and on section the kidney looked normal. The kidney was sewn up and replaced. While in the hospital the hemoglobin rose to 85 per cent. Since that time the patient has remained perfectly well and there has been no recurrence of blood in the urine.

Case 8.—Dr. L. N. S., Sanatorium Number 234. October 15, 1895.

The patient in this case was a physician. The hemorrhage was from the right kidney. The urine contained, in addition to albumin, blood, hyalin and granular casts. The bleeding was entirely from the right side. The condition was chronic interstitial nephritis. A nephrotomy performed on the right kidney in the usual manner immediately controlled hemorrhage. There was a cessation of hemorrhage in this case. Patient remained well until his death some years later.

Case 9.—Mrs. F. H. V., Sanatorium Number 850. Age 64. April 2, 1900.

The family history was unimportant; also the past history. The present trouble had been in existence for about 15 weeks, and consisted in frequent recurring attacks of hematuria, associated with a marked stinging sensation in the bladder, but no pain referable to the kidneys. The patient was a delicate-looking woman. The temperature was normal, and there was no evidence of disease except the hematuria. The urine, except for the blood, was normal. Neither kidney was palpable or tender. On cystoscopic examination the blood was found coming entirely from the left kidney. Functional tests showed that the two kidneys were equally active. The wax-tipped catheter was not scratched. X-ray was negative. The capacity of the renal pelves was normal. The patient in this case was kept quietly in bed for several weeks and the attacks ceased. She then went home, and the bleeding began to recur with attacks every six or seven days. She was almost confined to her bed. After six months the severity of the bleeding became less and the intervals greater. By the fall of 1901 they had entirely ceased. This patient, nearly 75 years old, is still living and has had no recurrence.

Case 10.—Mrs. A. B. Age 36. January 2, 1907.

Family history tubercular. The patient, when about 17 years old, had a severe attack of hysteria, but has otherwise been well. Her trouble began in April, 1900, with a slight attack of renal colic on the right side, followed by hematuria. A month later she was operated on for extra-uterine pregnancy. In 1902 there was a severe attack of renal pain in the left side, lasting for half an hour. In September, 1905, she had a severe attack of colic in the left side, accompanied by marked hematuria. Since then every menstrual period has been preceded by a similar attack. Numerous X-ray pictures show nothing. In July, 1906, the uterus was suspended and adhesions about the site of old operation on the left side cut. The left ovary was also removed. The patient in this case was a healthy-looking woman. At the time I saw her, March 8, 1897, the urine was perfectly normal. Both kidneys were catheterized. The urine collected from each side was normal and equal. The left kidney was injected and the pelvis found to contain 7 c. c. of fluid. Following this injection and beginning a few hours later the patient had a severe hematuria, lasting several hours.

Case 11.—Mrs. S. B., Gynecological Number 9,357. Age 59. January 23, 1902.

Family history was unimportant. The patient had scarlet fever when a child, but no other illnesses. She was the mother of nine children. Her present trouble had been in existence for a month, and consisted of blood in the urine

and some pain in the right kidney region. The patient was of small frame but well nourished. Temperature and pulse normal. There was a spot of reddening in the base of the bladder. There were white and red blood-corpuscles in the urine. No organisms were found. The spot in the bladder cleared up promptly on treatment. She continued, however, to have pain in the right side, and there was bleeding from this kidney. The urines from the two kidneys were identical except that in the right there was blood, and in the left no blood. The amount of blood was rather small. Injection of the right kidney produced intense pain. The X-ray was negative and there were no scratch-marks. This patient declined operation, and a year and a half later was still having her symptoms. She has been lost sight of since then.

Case 12.—Mrs. E. B., Gynecological Number 13,967. Age 20. July 2, 1907.

Family history was negative, also past history. The patient had one child three years old. For several months she had had severe pain in the right side associated with blood in the urine. Since its first appearance the blood continued in rather large quantities. The patient was a rather slightly built woman; heart, lungs, and temperature normal. The blood was coming entirely from the right kidney, which was secreting as much urine as the left. She remained in the hospital six days and the bleeding ceased, but the pain remained. Two years later she wrote that she had had no recurrence of the bleeding, but had had almost constant pain. The X-ray and the wax-tip gave negative results in this case. The patient refused all operative treatment.

Case 13.—Mrs. A. S. G. Age 36. February 26, 1907.

Family history and past history entirely negative in this case. Seven years before, her present trouble began with a severe attack of pain in the right kidney. There was aching in this side afterward for six months and it was associated with blood in the urine. In the fall of 1905, five years later, there was another attack of pain, which lasted several weeks. In the spring of 1906 the next attack of pain occurred. This was followed by frequent attacks during the summer of 1906. In the fall of 1906 she began noticing blood in the urine. The attacks continued up to the time she came to us. Neither kidney was palpable or tender, and the patient's general condition was excellent. This patient was examined first during an attack of bleeding. The hemorrhage was found to be coming slowly from the right kidney. The two kidneys were functioning equally. The bladder was normal. There were no abnormal constituents except blood in the urine. Injection of the right kidney reproduced the pain. Tuberculin was negative, as well as the X-ray and wax-tip cultures. Following the catheterization this patient remained well for several months.

Since then, however, there have been some recurrences. The amount of hemorrhage is never great in this case.

Case 14.—Mrs. M. S., Gynecological Number 11,321. Age 43. Admitted May 31, 1904.

The family and past histories were negative. The patient had had five children. Her trouble consisted of blood in the urine. No pain. This blood had been present for two months. The amount of blood was not great. The general physical condition of this patient was excellent. Bladder examination showed that the bleeding was entirely from the left kidney. The two kidneys were secreting approximately equally. This patient was kept in bed and went home on June 16 entirely well. Six months later she was still well. Has been lost sight of.

Case 15.—Miss E. W., Gynecological Number 8,375. Age 47. Admitted December 10, 1900.

The family history in this case was tubercular, but the patient had always been a healthy woman. She began bleeding in February, 1900. The only symptom was blood in the urine. This was constantly present. The urine except for the blood was normal. Both kidneys were very movable. The hemoglobin at the time of observation was only 27 per cent. The bladder examination showed that the bloody urine was coming solely from the right kidney. The patient's right kidney was catheterized by Dr. W. W. Russell, and 15 c. c. of a 10 per cent. solution of adrenalin injected into its pelvis. The bleeding stopped at once and never recurred. In March, 1901, hemoglobin had reached 80 per cent.

Case 16.—Mrs. M. J., Gynecological Number 12,335. Age 32. Date of admission September 6, 1905.

The family history negative, as well as the past history. The patient had had pain in the left kidney and blood in the urine for three months. The urine was otherwise normal. Neither kidney was palpable; no evidence of any general disturbance. On cystoscopic examination the bladder was normal. The blood was found to be coming from the left kidney entirely. This patient was about five months pregnant. No operation was done, but by being kept partly in bed the bleeding entirely ceased, and the pain was better. This patient went home and has been lost sight of.

Case 17.—Mrs. L. L., Gynecological Number 11,818. Age 34. Admitted January 18, 1905.

The family history in this case was markedly tubercular, and the patient's past history indicated pulmonary tuberculosis now healed. The patient had had several children. The present illness had been in existence for 14

years, and consisted of attacks of colic beginning in the region of the left kidney and radiating downward toward the bladder. There were no symptoms of bladder disturbances. The urine was perfectly normal. The general physical examination showed a well-nourished woman. No evidence of the tuberculosis could be found in her lungs. The left kidney was not palpable; the right kidney was palpable, but apparently normal. On catheterizing them, both kidneys found to be secreting actively. Injection of normal salt solution into pelvis of left kidney brought on attacks of pain similar to those with which the patient suffered. This patient was operated on, January 23, 1905; a kidney was exposed through the lumbar incision and found to be normal-looking. Its pelvis contained no stones. A nephrotomy was done. The incision of this operation healed promptly, and the patient was entirely relieved of her attacks of pain.

Case 18.—Mrs. E. B., Gynecological Number 13,522. Age 46. Admitted January 21, 1907.

The family history as well as the past history was entirely negative, except that in January, 1905, she had an operation for fistula in ano. Her present illness dated from a fall ten years before, since when there had always been pain in the left kidney. This had been so severe as to confine her to the bed most of the time, and the pain was made much worse by the menstrual period. The patient was a well-nourished woman; the urine contained a trace of albumin, but no other abnormal elements. The pelvic organs normal. Neither kidney palpable, but there was a slight tenderness in the region of the left. The bladder found normal. Both kidneys catheterized. Ten c. c. of fluid injected into the pelvis of the left kidney reproduced the pain. There was a trace of albumin in urine from both kidneys. The urine from each kidney was equal. Operation on January 23, 1907. The entire ureter explored and found normal. The kidney examined and found normal; not movable. The incisions healed promptly in this case, and the patient went home entirely relieved.

Case 19.—Mrs. J. B., Gynecological Number 7,948. Age 26. Admitted July 9, 1900.

The family and past history were entirely negative. Present illness consisted of attacks of pain for about two years in the right kidney. The kidney was slightly movable. The urine contained blood cells and albumin. Catheterization and injection of the right kidney reproduced the pain. Operation performed July 11, 1900. The right kidney was explored; no stone found. The kidney was suspended. Patient made an uninterrupted convalescence, and six years later wrote that she had no return of pain.

Case 20.—Miss P. R., Sanatorium Number 2,504. Admitted June 17, 1907. Age 16.

Family and past history negative. The patient in this case had had trouble for three years. Pain was constantly present but was varied in intensity; was gradually growing worse. Always increased at menstrual periods; not influenced by posture. Began where left ureter crossed pelvic brim and radiated toward the leg on the left side. Once or twice there was blood noted in the urine. There was some frequency of urination during the day. The patient had had almost every variety of rest cure and medicinal treatment without relief. The general physical examination showed that the girl was quite healthy. X-ray picture of the kidney was negative. The kidney was not movable. The urine was perfectly normal. Both kidneys found to be functioning equally and normally. Seven c. c. of fluid injected into the left kidney produced the pain that the patient complained of. Operation. Muscle-splitting incision at McBurney's point. The ureter was exposed from pelvic brim to kidney. No disease was found. This patient made an uninterrupted convalescence and has remained well.

Case 21.—Miss A. W., Gynecological Number 10,365. Age 40. Admitted March 28, 1903. Discharged April 25, 1903.

Family history in this case was markedly tubercular, but the patient had always been well. Her present illness had lasted for ten years. The onset was intense pain in the back, nausea and vomiting, and frequency of micturition. The pain was constant, but also exacerbated in attacks. Physical examination showed the patient was rather poorly nourished. No evidence of disease was evident elsewhere than in the kidney. The urine was perfectly normal. Neither kidney movable. The right kidney was catheterized and found to be secreting. Eight c. c. of fluid injected reproduced the pain. On April 3 incision was made down to the right kidney, which was found normal-looking. It was suspended with three silk sutures to the last rib. This patient subsequent to her operation was entirely relieved of her attacks of pain, but still had a dull aching.

Case. 22.—Mrs. M. L. F., Sanatorium. Admitted June 1, 1900.

The family history as well as past history negative. The patient had had backache for many years, and for three years had had severe dull aching pain in the right kidney regions. The pain also came in attacks and radiated through the leg. The right kidney had been suspended two years before without relief. The urine was normal. The patient was a healthy-looking woman. The right kidney was injected and brought on a typical attack of pain. In June, 1900, through an exploratory laparotomy the ureter was explored from bladder to kidney and found normal. The kidney was then explored from the lumbar region, was opened, and found normal. The incisions promptly healed in this case. The patient, however, was unrelieved of her pain.

Case 23.—Dr. N. H., Sanatorium Number 1,588. Age 55.

Family history negative. Past history began 12 years ago in an attack of renal colic. No trouble from then until the present. Present illness began one year ago. At intervals of five to eight weeks had been having severe attacks of pain in the right kidney. The pain lasted from three to forty-eight hours. The pain began in the right kidney and radiated down toward the bladder. During the attack micturition was increased in frequency and the urine sometimes contained blood. On physical examination the patient was a healthy-looking man. The urine was normal. The prostate gland was normal; bladder normal. Both kidneys actively secreting. Operation October 13, 1903. Lumbar incision down to right kidney. The kidney was normal in size and shape. There were adhesions between the upper pole and the fatty capsule, and over the kidney at several places were noted thickenings of the capsule with depressions. The kidney was decapsulated. Small piece of kidney tissue was removed for examination. This proved to be quite normal. The incision healed promptly in this case; the patient was relieved, and seven years later the report was brought of no recurrence.

Case 24.—Miss L. C., Sanatorium Number 2,320. Age 48.

Admitted January 14, 1907. Family history good. Past history good. The present illness consisted of attacks of pain in the right kidney region associated with frequency of micturition. The patient in this case was anemic-looking, hemoglobin 60 per cent. The urine contained albumin and hyalin and granular casts. The urine from the two kidneys was identical. Injection of the right kidney reproduced pain. On a milk diet, rest in bed, and water this patient was relieved of her pain, but there was no relief of the nephritis.

CHAPTER XIX.

TUBERCULOSIS OF THE KIDNEY.

HISTORY.

Study of tuberculosis of the kidney is distinctly modern, for practically all present-day understanding of the condition has been elaborated during the past century, most of it during the past twenty years. The first recorded case is that of the celebrated pathologist, Morgagni ("De Sedibus et Causis Morborum," 1767, iv, 336), who, while doing an autopsy, found that the left kidney was tuberculous through an extension of the process from a large mass of contiguous lymph glands. During the early years of the nineteenth century a number of isolated clinical studies and autopsy reports of tuberculous kidneys were made. Some of the old observers showed a keenness that stands in marked contrast to many of our reports at the present time. Howship ("A Practical Treatise on the Symptoms, Causes, Discrimination, and Treatment of Some of the Most Important Complaints that Affect the Secretion and Excretion of the Urine," 1823) recounts the histories of two patients in a most thorough way, pointing out the frequency with which all the symptoms may arise from the bladder, while the kidney itself, the actual seat of disease, gives no indication of disorder. It is the one peculiarity of tuberculosis of the kidney which to this day confuses so many physicians and leads to useless and harmful treatments of the bladder, through a failure to recognize that the kidney is at fault.

Rayer ("Traité des maladies des reins, etc.," 1841), making a full report of 16 cases, was the first to attempt a systematic investigation and classification of the condition. He made three subdivisions:

- (1) Those where the kidney is involved conjointly with a number of other organs, and no local symptoms develop from the kidney.
- (2) Those where the disease is limited to the kidney and its pelvis.
- (3) Those where the disease, in addition to involving the kidney, has also attacked the bladder alone or the bladder and the genital organs (urogenital tuberculosis).

It is impossible to pass on without referring to the remarkable watercolor

illustrations of tuberculous kidneys, pictured in Rayer's "Atlas." These will always remain as models of illustrative work and give us a conception of how thorough his work was. In spite of this advanced investigation, little general interest was manifested in the disease for many years. Schmidtlein (*Dtsche. Klinik*, 1863, xv, 185; 264) described the two modes of the spreading of tuberculosis in the urinary tract and laid the basis for the ideas of urogenital tuberculosis which persist to this day. Up to 1890 practically all observers held that the so-called ascending tuberculosis, which began in the genital organs or bladder and involved the kidney by extension up the ureter, was the common method by which the kidney became infected. To-day we know that the kidney is practically always infected through the blood, and the infection of the lower urinary organs is secondary to it.

Only a very few autopsy reports, where tuberculosis was found limited to the kidney alone and the rest of the body clear, are found in the literature; but such a condition was observed by Lancereaux, 1872.

Surgical operations on tuberculous kidneys followed closely on Simon's demonstration (1869) that one kidney could be removed and its fellow carry on the necessary elimination of urine.

Bryan (1870) removed a tuberculous pyonephrotic kidney without recognizing it to be such. Peters (*N. Y. Med. J.*, 1872, xvi, 473), operating for what he thought was a calculous pyonephrosis, found the condition tuberculous, and removed the kidney. This was the first deliberate nephrectomy for renal tuberculosis. In 1885 Gross the younger was able to collect from the literature twenty cases of nephrectomy for renal tuberculosis with eight deaths immediately following operation, and so many more occurred in a short time that eminent authors, such as Dickinson and Morris, openly questioned the propriety of ever removing a tuberculous kidney.

Precise grouping of all the tuberculous diseases under one head was made possible by the discovery of Koch (1882), who isolated the tubercle bacillus and showed its relationship to scrofula, pulmonary consumption, white swelling, and the various other tuberculous manifestations with which we are so familiar.

Babes (1883) demonstrated tubercle bacilli in the urine of a patient suffering with a tuberculous kidney and advocated this now much used method of examination for help in diagnosis of the condition.

But operative attempts at the treatment of kidney tuberculosis were desultory, indifferent, and half hearted until the nineties of the last century. In large measure lack of confidence arose from the belief that tuberculosis of the kidney was but the end stage of a tuberculosis of the entire urinary tract. The distinguished urologist, Guyon (*Ann. d. mal. d. org. génito-urin.*, 1888, vi, 577)

declares: "We do not know of a single case of renal tuberculosis primitive and unilateral without lesions of the same kind in the bladder, the seminal apparatus, or other organs." The valuable pathological work of Steinthal (*Virchow's Archiv*, 1885, c, 81) was the first upset to this view. In a series of twenty-four autopsies upon patients suffering with genito-urinary tuberculosis he found the kidney involved in every case; the lower tract in only 50 per cent. of the cases; while in nine instances the kidney alone was involved. Prior to his report autopsy findings had already demonstrated that in one-half the cases of renal tuberculosis only one kidney was involved. Furthermore his investigations were presented with such directness and clearness that numerous pioneer surgeons boldly began removing the diseased organs. Between 1890 and 1900 the names of Israel, Albarran, Morris, Tuffier are inseparably connected with the marvelous progress of surgery in treating this condition. During this period, too, were born modern cystoscopy and catheterization of the ureters. This method of examination quickly showed that kidney tuberculosis was often unilateral, demonstrated which side was involved, and lent so much certainty to the surgical work that all disputes as to this question had almost died out by 1900. It is of interest, in view of our present attitude, to consider the diatribes aimed at catheterization of the ureters by many of the leading men of that period.

THE OCCURRENCE OF KIDNEY TUBERCULOSIS.

Twenty years ago the surgical form of renal tuberculosis was considered rare. With our ability to recognize the disease and to disseminate widespread knowledge in regard to it, we now know how common an occurrence it is.

The actual frequency, owing to incompleteness and inaccuracy of vital statistics in the Health Departments of this country, cannot be stated. It is necessary, therefore, to fall back on the less representative autopsy records of general hospitals. Naturally, the frequency of the condition in these hospitals varied with the character of the patients admitted, much higher percentages being observed in those institutions freely admitting sufferers with pulmonary tuberculosis than in those which excluded such patients. For this reason, it seems more systematic to consider the statistics of occurrence in a classified order, which we will do under seven headings:

(1) The frequency of tuberculosis of the kidneys at autopsy without reference to the class of subject admitted to hospital.

(2) The frequency where there is active tuberculosis in some other part of the body.

- (3) The frequency of miliary tuberculosis.
- (4) The relative frequency of miliary and caseo-cavernous tuberculosis of the kidney.
- (5) The influence of age.
- (6) The proportion of unilateral to bilateral cases in caseo-cavernous tuberculosis.
- (7) Renal tuberculosis without the disease being present elsewhere.

Now, taking these questions categorically:

(1) **Frequency of Autopsies of Tuberculous Kidneys, Without Any Reference to Particular Class of Subject.**—The combined statistics from five great hospitals show in 12,688 autopsies 603 tuberculous kidneys, or a proportion of 4.7 per cent. The individual percentages varied from 2.2 per cent. to 5.6 per cent. (General Hospital of Prague; Tilden Brown's Report, Presbyterian Hospital, New York; George Walker, Johns Hopkins Hospital Report, 1904, xii, 455; Henry Morris' report, Middlesex Hospital, London, also "Surgical Diseases of the Kidney," Morris; and Posner's records, cited by Walker.)

The statistics are:

	<i>Autopsies</i>	<i>Tuberculosis of Kidney</i>	<i>Per Cent.</i>
Prague Gen. Hosp.....	4,536	256	5.6
Tilden Brown	567	23	4.
George Walker	1,369	61	4.5
Henry Morris	3,331	74	2.2
Posner	4,710	189	4.

(2) **Frequency of Kidney Tuberculosis at Autopsy with Active Tuberculosis Present in Other Organs.**—The importance of information as to the number of tuberculous patients admitted to a hospital in estimating the frequency of disease is well shown by the fact that in tuberculous patients the percentage of renal tuberculosis runs from 12 per cent. to 33 per cent. in the statistics of Posner, Brown, and Walker. These are as follows:

	<i>Cases</i>	<i>Tuberculosis of Kidney</i>	<i>Per Cent.</i>
Posner	789	189	26
Brown	68	23	33
Walker	482	59	12

Combining the statistics of these authors, it is seen that 20.2 per cent. with pulmonary and other active forms of tuberculosis that come to autopsy have tuberculosis of the kidney.

(3) **Frequency of Kidney Involvement in Cases of Miliary Tuberculosis.**—Just how many of the cases had miliary tuberculosis is even more important in considering the statistics, because, in almost every case of this form, there is involvement of the kidneys with the tubercles. Walker, for example, in thirty-six cases of miliary tuberculosis found both kidneys involved in every one. Morris, in twenty-nine, found bilateral involvement in twenty-eight, and one kidney involved in one case.

(4) **Relative Frequency of the Miliary and Caseo-cavernous Forms.**—In adults acute miliary tuberculosis of the kidney occurs on the average about twice as frequently as the caseo-cavernous form, but, as Dickinson pointed out, in children the preponderance of the miliary form is much more marked, and this accounts for the greater frequency of renal tuberculosis in children. In adults the frequency is illustrated by the findings of Morris and Walker. Morris, in forty-nine cases of renal tuberculosis, had twenty-nine miliary and fifteen caseo-cavernous kidneys, while Walker, in forty-nine, had thirty-six miliary and twenty-three caseo-cavernous types.

(5) **Influence of Age on Frequency of Miliary and Caseo-cavernous Tuberculosis.**—The greater frequency of kidney tuberculosis in children is due to the fact of the more frequent occurrence of miliary tuberculosis among them. The surgical form of tuberculosis, however, is more commonly met with in adults. The youngest case we have ever had personally was sixteen years old. It is interesting to note that Morris in his large statistical studies has never met with a case under ten years of age.

S. M. Hamill (*Internat. Med. Mag.*, 1895-6, iv, 881), however, has especially investigated the occurrence of the caseo-cavernous form in children, and collected fifty-five cases out of the literature. Two were under one year, thirteen between one and five, eleven between five and ten, and twenty between ten and fourteen. Posner, again, who estimates that 25 per cent. of adults with active tuberculosis of the lungs or elsewhere have renal involvement, states that 49 per cent. of children show it.

Barthez and Rilliet ("Traité clinique et pratique des maladies des enfants," 1884-91, iii, 852), in three hundred and twelve autopsies on children under twelve, found forty-nine cases of renal tuberculosis, making 15 per cent., which stands in marked contrast to the 4.7 per cent. occurring in adults. They found also, that in seventy-two active tuberculous cases, forty-nine, or sixty-eight per cent., showed involvement of the kidneys. As already stated, this

great increase in frequency in children is due to the relatively greater frequency of miliary tuberculosis.

Vignard and Thénevot (*J. d'urolog.*, 1912, i, 323) have recently reviewed this matter in a most interesting way, reporting 47 cases of surgical tuberculosis in children. They mention the case of Bardenheuer, who saw the disease in an infant three months old, and note that the right side is more frequently involved than the left, that there is a slight percentage more in males than in females, and that the disease is almost always unilateral.

In small boys there is often associated involvement of one of the seminal vesicles and prostate. As in the adult, the principal symptoms are those from the bladder. In the early stages the frequent occurrence of nocturnal incontinence is quite pronounced. The diagnosis and treatment are the same as in the adult. Where the disease was unilateral 12 permanent cures followed nephrectomy.

(6) Frequency of Unilateral Renal Tuberculosis of the Caseo-cavernous Form, in Proportion to the Bilateral Involvement.—From its very beginning the miliary form of tuberculosis is nearly always bilateral, but this is not true of the caseo-cavernous form, and on this fact the surgical treatment of the disease is largely based. We believe almost every case of caseo-cavernous tuberculosis begins as a unilateral disease, and that it remains so for a long time is amply shown in both autopsy and clinical studies. The influence of age and the influence of active tuberculosis in other parts of the body have bearing here, also, in that children are more likely to have the bilateral form, and a patient suffering with active pulmonary tuberculosis is more apt to have the bilateral form than one without such a lesion. One of the earliest authors to urge the frequency of unilateral involvement was Dickinson, his views being clearly set forth in his text-book on "Diseases of the Kidney." Authors who have particularly investigated autopsy findings with reference to this point are Fisher (*Thèse de Paris*, 1892); Vigneron (*Thèse de Paris*, 1894); Hallé and Motz (*Ann. d. mal. d. org. génito-urin.*, 1906, xxi, 161). Combining their statistics, out of four hundred and fifty-nine autopsy subjects with caseo-cavernous tuberculosis, two hundred and fifty-three showed only one kidney involved, which gives a percentage of 55.1 per cent. This means that even in extreme stages of the caseo-cavernous form more than half had only one kidney involved by the tuberculous process.

Morris, emphasizing the difference between children and adults with caseo-cavernous renal tuberculosis, notes, in twenty-eight children under twelve who came to autopsy from this disease, that one kidney was involved in only nine cases, making 32 per cent.; whereas, in fifty-seven over twelve years of age,

twenty-nine, or 50.8 per cent., were unilateral. So the chances of both kidneys being involved in a child are almost twice as great as in an adult.

A common autopsy finding is the total involvement of one kidney, and partial involvement of the other. Indeed, it is a rare exception to find the kidneys equally involved. The study of cases operated on adds to this finding, suggesting that at the earliest stage kidney tuberculosis of the caseo-cavernous type is probably nearly always unilateral. Most of the cases which come to operation are in patients who have been suffering for a long while. Israel estimates from his operative results and clinical findings that only 9 per cent. are bilateral; in other words, that for every case of bilateral tuberculosis of this type there are nine unilateral, and a careful analysis of our own cases leads to the same conclusion.

Taking first those cases where there has been no evidence of tuberculosis elsewhere in the body, and where the disease is limited to one kidney, we have had thirty-four such patients. In every one, operation has seemingly produced a permanent cure. Some of them had been suffering from the disease for a considerable time, but the absence of bladder involvement justifies putting them among the early cases. Taking this series of early cases, we have 100 per cent. of unilateral occurrence, but, in contrast with these, are sixty-four where there was marked involvement of the bladder at the time they came for treatment. Nineteen of these have remained well.

The greater frequency of bilateral involvement in those cases where there is evident active tuberculosis in some other part of the body has been noted by Morris, who states that out of ten cases limited to the kidney alone, only one was bilateral, whereas in sixty-four with marked disease elsewhere twenty-one were bilateral. We have had thirty-nine cases with active tuberculosis present elsewhere in the body, most of them pulmonary, whose subsequent history has shown that fifteen were unilateral and three bilateral. Just as in autopsy findings, so in clinical, the presence of active tuberculosis of the lungs or of other parts of the body is shown to give greater chance of bilateral involvement.

(7) Frequency of Occurrence of Primary Renal Tuberculosis Without Evidence of Tuberculosis Elsewhere in the Body.—Rayer was the first to suggest the possibility of tuberculosis limited to the kidney, though Hiss evidently assumed that such a condition might exist. The great frequency of healed foci of tuberculosis in the bronchial glands, in the lungs and elsewhere makes it extremely difficult definitely to determine the tuberculous focus in the kidney the primary focus in the body. To explain such a lesion we have to assume that the tubercle bacillus has entered into the body and passed into the blood without localizing until it reaches the kidney. Clinically, primary renal tuberculosis cannot be

shown; our only source of information must be from autopsy studies. The necessary rarity of such a finding at post-mortem is understandable when we consider the progressive nature of the disease. A patient who dies with a tuberculosis limited to one kidney does not die primarily from this cause. Albarran has collected five instances from the literature. One is the much quoted case of Israel (*Dtsche. med. Wchschr.*, 1898, xxiv, 443), who reported the autopsy findings in a boy of eight years, where there was tuberculosis limited to one kidney—a pathological rarity, for in the large statistical studies of Steinthal, Vigneron, Morris and Walker no such are described.

It is not uncommon to find advanced tuberculosis of the kidney and only slight tuberculosis in some other part of the body. Walker's conclusion is that several of his cases must have been primary in the kidney. Steinthal in one case found only a small ulceration in the rectum with a cheesy bronchial gland.

Taking the frequency of primary renal tuberculosis from the clinical standpoint, the figures are different. Here primary renal tuberculosis is a disease in which there is renal tuberculosis, but no signs of tuberculosis in any part of the body and no history of such trouble. Israel, for example, found twenty-two out of thirty cases, or 73 per cent., to be cases of primary renal tuberculosis. Out of our hundred cases the disease was limited to the kidneys or the kidneys and bladder in thirty-eight, or 61 per cent. In every case of bladder tuberculosis, with one possible exception, as we show later, the disease was apparently primary in the kidney, and the bladder secondarily involved. In thirty-eight an operation was done, and all have now passed over more than six years without return or evidence of tuberculosis elsewhere.

PORTAL OF ENTRY OF TUBERCLE BACILLUS TO THE KIDNEY.

The essential cause of kidney tuberculosis, like that of tuberculosis everywhere, is the tubercle bacillus. By what route the tubercle bacillus reaches the kidney and what determines its development when once it is there, are important questions. Three principal routes have been described, talked about and much discussed, while opinions as to their frequency have materially altered with time.

- (1) Through kidney capsule by direct invasion from an infected contiguous organ.
- (2) Through ureter.
- (3) Through arterial blood system.

Before 1890 and before Steinthal's work, practically all kidney tuberculosis were regarded as developing from an extension of the process in the blad-

der up through the ureter, but we now recognize infection through the arterial vessels by means of tubercle bacilli carried in the blood, as the most frequent and important cause. Other routes suggested have but little experimental or autopsy evidence in their favor as to actual occurrence. Albarran pointed out a venous anastomosis between the two kidneys through the inferior diaphragmatic veins and suggested it as transmitting infection from one kidney to the other, affording an additional reason for doing nephrectomy on the tuberculous kidney to save its healthy fellow.

Many have suggested that the tubercle bacillus is carried into the kidney by means of lymph vessels, but against this is the fact that there are no lymph vessels passing from the outside into the kidney. All lymph vessels flow from the kidney outward, and, as we show later, infection by the tubercle bacillus rarely occurs against the stream.

Taking in order the three recognized routes:

(1) **Infection of Kidney Capsule by Direct Invasion from an Infected Contiguous Organ.**—In practice we have never met with such a case, but there are many well-authenticated instances in the literature. Indeed, the first tuberculosis of the kidney on record, as already noted under history, was an extension from the lumbar lymph glands (Morgagni, 1767). Rayet reports two cases where involvement took place from an extension of the process from the vertebral column. Newman ("Lectures to Practitioners," also "Surgical Diseases of the Kidney") has described a case coming from a tuberculous empyema. J. Patoir (*Méd. moderne*, 1897, viii, 529) describes most interestingly a case of a girl of nineteen where both kidneys were involved through an extension from a tuberculosis of the vertebral column. Tilden Brown has laid great emphasis upon the resistance of the capsule of the kidney to penetration by a tuberculous process on the outside; this is perhaps explained by the direction which the lymph vessels take. Brown urged that care be exercised in removing a kidney for perirenal tuberculosis when the urine is perfectly normal. Not a few of these perirenal tubercular abscesses take their origin from the adrenal glands, a fact of anatomical and pathological interest rather than of practical clinical importance, both because of the rarity of occurrence and because the other tuberculous processes dominate the field.

(2) **Extension Through Ureter.**—The importance of this mode of infection has been greatly reduced in the minds of urologists during the last ten years, not a few holding to-day that it never occurs. Most observers hold it extremely rare, and even its strongest advocates, notably Pousson, think it less frequent than extension through the blood. Yet at one time it was credited with being the road of infection in almost every case, a view which arose from the fact

that most cases of tuberculous kidney gave evidence of disease, first, by symptoms from the bladder. Most cases experience extreme vesical distress for a long time before there is any evidence whatever that the kidney is involved. Kidney tuberculosis was, therefore, for a long time believed to be merely a part of a urinary tuberculosis, the primary source being either in the bladder or in the genital organs and, as during the eighties of the last century practically all observers maintained this view, any operative work on tuberculous kidneys was discouraged. This view of extension up the ureter led to the use of the term ascending uro-genital tuberculosis, while that form which started in the kidney and spread to the bladder was called descending uro-genital tuberculosis.

An interesting method of extension up the ureter to the kidney has been observed in a few cases. This consists in a perforation of the ureter by some focus of infection outside it. Bab had such a case, in which a tuberculosis of the prostate led to direct invasion of the ureter and extension up to the kidney, and Tuffier one where primary tuberculosis was in the spinal column, and thence, by rupture into the ureter, the kidney was involved. The ease with which such extension can occur is suggested by the frequency with which renal colic accompanies appendicitis, while Dr. Hugh Young has commented on obstructions of the ureter through inflammatory processes in the seminal vesicles. We consider this ascending form extremely rare and cannot recall such a case. The infrequency of this condition in women, who have tuberculosis of the kidney quite as frequently as men, indeed more frequently in our experience, is shown by the extreme rarity of vesical primary tuberculosis without tuberculosis of the kidney. We have had only two cases of this description. In one both kidneys were explored in addition to an examination of the separate urines without finding any disease, in the other, the separate urines repeatedly examined were always normal, and both patients were relieved by bladder operations alone. One of these patients we have since taken out of this class. She had had no symptoms from the kidney, and the urine from each side had been clear. Two years ago she came in for an investigation, her operation having been done in 1902. The urine was still clear, but an examination showed the functional capacity of the left kidney greatly reduced. The patient has been well at all times. This finding is interpreted as a healed tuberculosis of the left kidney and, if so, is a rather unique example of this kind of cure.

In men tuberculosis of the bladder is much commoner, this being due to the close union between the urinary and genital organs. Contrary to the generally accepted view, we consider genito-urinary tuberculosis, that is, involvement of both genital and urinary organs, about as frequent in women as in men,

but the association is not so intimate. Dr. George Walker has communicated an experiment on a dog, where by artificially producing a tuberculous ulcer in the bladder, he got an extension of the process to the left horn of the bicornuate uterus, which would seem to suggest an association between the two foci.

In the male, renal tuberculosis and epididymal tuberculosis when they occur together are independent affections, a view which is now most generally accepted and which we hold, contrary to the old one, that a tuberculosis either started in a kidney and extended to the bladder and from the bladder to the epididymis, or exactly the reverse.

Take now the three lines in which observations have been carried on: The study of post-mortem specimens; Animal experimentation; Clinical studies on the living.

(1) POST-MORTEM SPECIMENS.—So far as we are able to discover there is not a single case on record where tuberculosis has been found limited to the bladder and ureter. Such cases, if common, would have been recorded. Also, the majority of specimens studied show the tuberculous process in the kidney to be manifestly older than that found in the bladder. Again, there are many cases recorded with one tuberculous kidney and bladder tuberculosis, so extensive that the ureter of the sound side stands up in it like a foreign body, but with no involvement of either the ureter or its kidney. The mere frequency of one-sided renal tuberculosis in autopsy subjects, about 50 per cent., speaks against this mode of infection, especially when it is realized that the cases are usually chronic, the opportunity of infection long present, and the patient evidently susceptible to the disease.

(2) ANIMAL EXPERIMENTATION.—The first investigator here was Albert Cayle (*Thèse de Paris*, 1887), who injected a culture of tubercle bacillus directly into the bladders of rabbits, or in some cases directly into the ureter after it had been tied off, an experiment which enabled him to produce tuberculosis of the bladder, but in no case an ascending tuberculosis involving the kidney. On the other hand, by injecting tubercle bacilli directly into the kidney, he not only produced renal tuberculosis, but found the process extended downward to the bladder. Therefore, Cohnheim's view that genito-urinary tuberculosis is essentially a disease of excretion, and that infection follows the same course as the excretion, had his warm support. Baumgarten (*Arch. f. klin. Chir.*, 1901, lxxiii, 1019) repeated and extended Cayle's experiments, not only confirming his statement so far as the kidney was concerned, but further demonstrating that tuberculosis did not pass from the prostate gland and bladder to the epididymis, but by infecting the latter caused the prostate gland and bladder to be secondarily infected. In other words, in the genital system, just

as in the urinary, the infection followed the course of excretion. He also proved, by injecting tubercle bacilli into the urethra of rabbits, that tuberculosis of the prostatic gland and bladder could be produced. Albarran (1901) was able to produce an ascending tuberculosis of the kidney by tying off the ureter and injecting tubercle bacilli into it above the ligatures. Rovsing was able to get an ascending tuberculosis of the kidney from the bladder of a dog in one case by first seriously injuring the bladder, then injecting tubercle bacilli and producing a twenty-four-hour retention of urine in the bladder, but he only succeeded in doing this in one out of a number of trials. In addition to rabbits and dogs, goats and guinea pigs have been experimented on and all with negative result. The failure to produce this ascension of infection in rabbits is particularly interesting, in view of the work of Loewen and Goldschmidt, who wished apparently to demonstrate reflux from the bladder up the ureters as occurring fairly often in this animal. By far the most complete and interesting work in this connection has been done by Dr. George Walker, in his studies in the experimental production of tuberculosis in the genito-urinary organs (*Johns Hopkins Hospital Reports*, 1911, xvi, 1), to which the reader is referred.

(3) CLINICAL STUDIES.—The efficient use of the cystoscope, the catheterization of ureters, and the studying of patients upon whom nephrectomy has been performed have done much to show the infrequency of ascending renal tuberculosis. The facts that militate against its occurrence are: firstly, the numerous cases of renal tuberculosis where cystoscopic examination shows a perfectly normal bladder; secondly, the marked and advanced disease of the kidney with involvement of the lower end of the ureter, with only a slight amount of fresh-looking bladder tuberculosis located principally around the orifice of the affected kidney; and, thirdly, the absence of all cases of normal kidneys with tubercular bladders and thickened, diseased ureters.

Clearly, then, infection of the kidney through the ureter is rare. But should it be entirely excluded? Those who believe in a direct extension now hold that with a normal ureteral orifice this extension can not occur, because normally there is no reflux from the bladder into the ureter. It is held, however, that changes result in the end of the ureter which harden it and prevent the normal valve-like closure. That such changes take place has been made evident to us in several cases. One of us, Kelly, removed a kidney, and there was a backflow regularly through the ureter which was left in. Again, in a case with double pyelitis and severe cystitis, any overdistention of the bladder would result in a backflow into the ureters, which could be easily demonstrated by filling the bladder with a solution colored with methylene blue. This con-

dition was demonstrated by Dr. John A. Sampson, then resident gynecologist at the Johns Hopkins Hospital.

The method of extension to the kidney through the ureter has been ascribed to direct progress of the disease, first, by crawling up the ureter, and, second, by being carried up in a reflux as already suggested.

(3) **Infection Through Arterial Blood System.**—This is by far the commonest and most important route by which the tubercle bacillus gets entrance to the kidney. This fact is confirmed by autopsy findings, experimental work, and by clinical experience. All cases met with were due to this source of infection. The organism comes, as a rule, from some other focus of infection in the body, although in very many cases met with in clinics this focus may be entirely hidden. In one hundred cases of our own, seventy-one apparently belonged to what might be called clinical primary tuberculosis, and in only thirty-nine was there any evidence or history of other tuberculosis. In the thirty-nine cases eighteen had foci in the lungs, eight in the Fallopian tubes, six in lymph glands, and six in bones. It must be kept in mind, however, that tuberculous infection is very common, so common that the great German pathologist, Virchow, stated that "Everybody has a little tuberculosis." It is very easy for an infection to escape the notice of both patient and examining physician. Walker gives the commonest primary origin as the lymph glands. It has been shown by many experiments that the tubercle bacillus can pass through the mucous membrane without leaving any trace of its passage. The best illustration is gained by feeding animals on tubercle bacilli, and developing infection in the retroperitoneal lymph glands, leaving the mucosa of the bowel perfectly normal. We mention only a few of the very numerous experimenters who have dealt with this subject. Practically all the work that has been done is confirmatory and adds little to that of Durand-Fardel (1885), who injected a culture of the tubercle bacillus into the renal artery and thereby produced an acute miliary tuberculosis of the kidney similar in all respects to that found at autopsy. Pels-Leusden (1905) has had the same results in goats. Asch (*Centrbl. f. Harn.- u. Sex.-Org.*, 1903, xiv, 183) had exactly similar results in dogs.

PATHOLOGY.

The tubercle bacillus after reaching the kidney sets up two distinct kinds of reaction: the formation of tubercles and the formation of fibrous tissue. This corresponds with the action of the tubercle bacillus and its toxin in other parts of the body. Depending upon the site of the tuberculosis and its development,

various gross pathological conditions develop which have been described, such as massive degeneration, nodular tuberculosis, papillary tuberculosis, pyonephrosis with tuberculosis of the kidney, etc. Before taking up and considering these various forms separately, let us follow the tubercle bacillus after it enters the kidney to determine its fate. There seems little or no doubt that it can, under certain conditions, pass through the kidney without causing any determinable lesions. This is exactly analogous to its passing through the mucous membrane of the intestine without leaving any trace of its passage. The evidence that it can so go through the kidney without leaving any lesion has been furnished by a number of investigators. Hugh Walsham (*Lancet*, 1901, ii, 311) first drew attention decidedly to this fact by showing that tubercle bacilli could be demonstrated in the glomeruli, in the uriniferous tubules and in the urine of cases of acute miliary tuberculosis, without any tubercles or other change in the kidney. Foulerton and Hillier (*Brit. Med. J.*, 1901, ii, 774) examined the urines of twenty-five patients suffering with pulmonary tuberculosis, and found tubercle bacilli present in only one. In doing this they used only the ordinary staining method. On the other hand, they injected guinea pigs from eighteen of these cases and of these eighteen nine developed tuberculosis. Three of the nine subsequently died of tuberculosis, but post-mortem examinations of the kidneys fail to show any evidence of the disease. Fournier and Beaufume (*Comp. rend. heb. d. séances et mém. d. l. soc. d. biol.*, 1902, No. 15, 1239) were able to find tubercle bacilli in almost every case of pulmonary tuberculosis by inoculating the urine into guinea pigs. The fact that even at autopsies only 25 per cent. of subjects with pulmonary tuberculosis show kidney tuberculosis also affords definite proof of the frequency of the passage of the organism without producing lesions.

The bacillus may locate and develop at any level or in any part of the kidney, but the common site of selection seems to be those glomeruli situated next to the medulla. The experimental production of miliary tuberculosis by Durand-Fardel, Cayle, Borel, Baumgarten, and Walsham indicates the glomerulus as the favorite seat of onset, the apparent reason being that the blood current is so slow at this point as to afford consequent increased growth and ease of implantation. The earliest change is a hyperplasia of the endothelial cells lining the blood-vessels. The bacilli pass out of the blood-vessels between these cells into the connective tissue, where are formed small masses of lymphoid cells which soon become epithelioid cells. These, however, as already indicated, are rarely involved without definite involvement of the kidney.

When a tubercle is started in the tissues around the blood-vessels there is distinct degeneration of the epithelial structures and tubules of the kidney

lying nearby, and not infrequently a marked round cell infiltration of the surrounding tissues (Fig. 275). The process may be general, or localized at one point, and the size of the individual tumor masses is determined by the number of tubercles present (Fig. 276). In places large numbers of tubercles fuse together to form nodules which soften in the center by caseation and form cavities (Fig. 277). Sometimes the cavity occupies a large part of the kidney, and in many cases these cavities communicating or not communicating with the pelvis may be larger than the original kidney. In addition to the formation of distinct tubercles with giant, epithelioid, or lymphoid cells, there is frequently a diffuse tuberculous process. Many of the latter kind are scattered through the tissue, and these seem to undergo a kind of degeneration, not to be confused, however, with the fibrous change so frequently found in kidneys the seat of tuberculosis, which change is apparently due to the toxin excreted by the tubercle bacillus. Practically all these cases show marked interstitial nephritis of a focal nature. In parts the kidney may appear almost normal, but in others there is a marked change. It is of great interest that Rayer thought 40 per cent. of all cases of tuberculosis were associated with nephritis, and that such frequency has been also dwelt on by Coffin, Albaran, and many others. We give some other authors, such as G. Salus (*Berl. klin. Wchnsch.*, 1903, xl, 1150), who, in twenty-seven cases of pulmonary tuberculosis, found 44 per cent. albumin and 51 per cent. casts. Then Lecorché and Talamon ("Traité de l'albuminurie et du mal de Bright," 1888) found albumin in 33 per cent. of all cases with pulmonary tuberculosis examined by them, while Bright, the original worker on kidney diseases, noted this frequently. These changes, it would seem, are probably due to toxins formed by the tubercle bacilli passing through the kidney. Numerous experiments on animals have demonstrated that tuberculin, when injected subcutaneously and repeatedly in large doses, leads to a parenchymous degeneration of kidney cells. An ether extract of tubercle bacilli

FIG. 275.—MICROSCOPICAL SECTION OF TUBERCULAR KIDNEY. Magnifications indicated under drawings. The larger drawing to the left shows the cortex and the very beginning of the medulla. The small squares show parts of section which are more highly magnified in drawing to the right. Note in addition to typical tubercles the widespread infiltration with small round and polymorphonuclear cells. The degree of this infiltration varies greatly with the case.

FIG. 276.—SECTION OF KIDNEY FROM PAPILLA TO SURFACE. Note wide extent of tubercular process which in this case is of the nodular fibrous variety. In contradistinction to the type shown in the preceding figure, there is marked cortical involvement. The large nodules result from a confluence of tubercles. Note typical tuberculous structures as indicated by giant cells. There is still considerable renal tissue present, both glomeruli and tubules. The amount of sclerosis due to fibrous tissue formation varies widely according to the case.

Tub. nodules pitting
capsule

in cortex

la.

artery

nodule with
infection

in medulla

in fat
renal

Tub. nodules in wall of calyx

FIG. 277.—TUBERCULAR PROCESS IN UPPER POLE OF KIDNEY. Lower figure. The shaded surface indicated by arrow shows the block from which the section shown in upper drawing was taken. The upper drawing is low-power, five times magnified. To the right is shown a cavity lined by thick, fibrous tissue. This is an end-stage of caseo-cavernous transformation. To the left, note transformation of medulla into caseous material; some of the large collecting tubules still persist. The cortex above is compressed, the tubules are for the most part occluded; many glomeruli are still intact and apparently functioning. Others show hyaline transformation. Note greatly thickened and sclerotic blood vessels. Note also great thickening of capsula propria of the kidney.

injected into a living organ produces tubercles which rapidly caseate, while, on the other hand, a chloroform extract produces tubercles which show no sign of caseation, but are finally absorbed and replaced by fibrous tissue. Bernard and Salomon (*J. de physiol. et de path. gén.*, 1905, vii, 303) were the first to demonstrate this most interesting fact, their experiments seeming to point to two toxins at work producing quite different results.

An extensive study of the kidneys of those dying of pulmonary tuberculosis has been made by Arthur Heyn (Inaugural Dissertation, Berlin, 1901), who found a focal nephritis, often manifest as little whitish areas resembling infarcts on the surface, to be also present in all parts of the kidney. Such lesions were frequently present along with positive tuberculous lesions, but also, in some cases, quite independent of them. These findings were confirmed by D'Arrigo. Examination of our own specimens convinced us of the very frequent occurrence of these areas of focal interstitial nephritis; not only every specimen, but in some cases almost every section shows them. Whether they are due to toxic action or the bacillus is, of course, not answerable. We have not been able to demonstrate tubercle bacilli in any of these areas, but that does not exclude the fact that they might at one time have been there. Some specimens, however, show very little change, and definite tubercles are met lying in among normal-looking tubules, which goes to show that in some cases the tubercle bacillus is more capable of producing toxins than in others; and where there is simply caseation without fibrous reaction, the assumption that we are dealing with a toxin similar to that obtained by ether extracts of the tubercle bacillus is suggested.

The process may long remain confined to one part only of the kidney, and the rest continue fairly normal and actively secreting. Here is a case:

Miss A. E. This patient had symptoms pointing to kidney tuberculosis for thirteen years. After removal, the kidney cavities were found occupying both poles, but the middle portion was well preserved and showed that active secretion was going on.

Infection of the kidney pelvis and the ureters in most cases would seem to be by the urine. The tubercle bacilli implanted on the mucous surface pass through the epithelium, and begin to produce typical tuberculous lesions in the layer of the mucosa immediately under the surface epithelium.

Gross Types of Kidney Tuberculosis.—Location of kidney; rapidity and extension of the process; condition of ureter; and presence of secondary infecting organisms may cause the appearance of a tuberculous kidney to vary immensely.

First as to occurrence of cavities. A large percentage of

advanced cases will show cavity formations: in fifty-five specimens we found them forty times: Paul Rosenstein found them thirty-one times in forty-eight cases.

FIG. 278.—KIDNEY SHOWING DISSEMINATED TUBERCULOSIS OF CORTX OF ITS UPPER POLE WITH SECONDARY DESTRUCTION OF PAPILLA. The rest of the kidney, with the exception of a small focus in cortex of lower pole, appears normal. Note the involvement of mucous membrane of upper calyx, while pelvis and lower calices appear free. Natural size.

Diffuse infiltrating tuberculosis without cavity formation is rarer. Rosenstein found three cases. We had seven. Excellent examples of both the cavernous form and the infiltrating form are shown in Figures 278, 279, 280, 281, 282, 284, and 285.

In our series no less than 27 specimens showed involvement of the apices of the pyramids. In only 1 case, however, was there solitary involvement of this part of the kidney. The clinical symptoms were marked hematuria. The condition is pictured in Figure 292.

Tuberculous kidneys are, as a rule, enlarged, the only exceptions being where they are so diseased that the kidney is replaced with fibro-fatty tissue which may contract and produce a very small organ. We observed four such specimens out of fifty-five, and three others in which there was no kidney enlargement.

Looking to the possibility of conservative surgery, it is of interest that in only seven was the disease limited to one pole, in four of which the pelvis and ureter were involved. Thus, out of fifty-five specimens only three evidenced that a resection could have entirely removed the disease. An excellent illustration of a condition where conservative surgery might be thought of is shown in Figure 281. Here is a double kidney with double pelvis and double blood supply, and the disease limited to one pole.

FIG. 279. — DIAGRAMMATIC REPRESENTATION OF UPPER POLE OF KIDNEY SHOWN IN LAST FIGURE. Note how destruction of papilla occurs not only from surface but in its interior, as shown in two little cavities indicated in shaded areas.

Closed Ureters. Concerning the influence of the closure of the ureter upon the development of the process in the kidney much has been written. Eleven of our specimens showed a closed ureter, in every case with enlarged kidney, and the largest we have belonged to this group. It showed the complete transformation of the kidney into a multilocular

thick-walled sac filled with caseo-gelatinous material, the so-called massive degeneration of Tuffier (Fig. 283). Some of the other specimens showed cavity formation and caseation; one diffuse infiltration with tuberculosis; another a small fibro-fatty kidney, the entire renal structure being replaced by this tissue, showing this transformation also possible with a closed ureter. Several of these latter specimens, examined microscopically, showed apparently good functional tissue in the kidney, the tubules and glomeruli being well preserved. In one there was a peculiar cystic transformation of the kidney, its entire surface being covered with cysts, with clear, thin walls and filled with clear fluid. The closure of the ureter seems to have no effect in producing perirenal involvement. Out of ten cases with marked perirenal abscesses, five had open and five had closed ureters.

Open Ureters. Not less important than transformations possible with a closed ureter are those possible with an open one. We had five cases which showed complete destruction of the kidney, one of these being a typical massive degeneration of Tuffier (Fig. 283); two others were greatly enlarged, but two

FIG. 280.—LARGE TUBERCULAR KIDNEY. The drawing to the left shows the anterior surface; that on the right is a cross section. Note in the superficial view the extensive distribution of the tubercles, surrounded by ecchymoses. The distended pelvis is filled with blood. Note that the upper and lower poles of the kidney are apparently healthy, except for a few isolated tubercles, which, however, would, render nugatory any conservative operation. (Ruark, patient of Dr. Hunner's, $\frac{5}{8}$ natural size.)

were smaller than normal. Thirty-three specimens showed an open ureter, and clinical studies before operation showed the kidneys were secreting through the ureters. Twenty-six were enlarged kidneys, three normal, three rather below normal. The type of involvement was always of the caseo-cavernous or of the diffuse form; none showed the massive degeneration of Tuffier.

Gross types, therefore, would seem to be dependent upon the original dis-

tribution of the disease, and upon either the virulence of the tubercle bacillus or the resistance of the kidney.

Secondary Infection.—Secondary infection does lead to a more rapid kidney

FIG. 281.—TUBERCULOSIS LIMITED LARGELY TO THE LOWER POLE OF KIDNEY, WHICH HAS TWO PELVES AND DOUBLE BLOOD SUPPLY. Note in longitudinal section of kidney normal upper half and almost completely destroyed lower half. Such a kidney affords the ideal type for resection, since both the ureters and the blood supply are quite separate. (S., Dec. 3, 1903; $\frac{5}{8}$ natural size.)

destruction than is brought about by tuberculous infection alone. It seems to be the favoring cause for perirenal abscess, although this may occur without it. Four cases where we have accurate bacteriological notes of perirenal abscesses due to tuberculosis, all showed infection with other organisms in addition to the tubercle bacillus.

PERIRENAL INFECTION.—In the development of perirenal abscess arising from the kidney, several modes of origin are possible. The organisms may extend from the kidney to the perirenal tissue by means of the veins, by means of the lymphatics, or by direct extension through the capsule (Fig. 282), as

FIG. 282.—TUBERCULOSIS OF LEFT KIDNEY. At one point, a, the ctuberular process has broken through the capsule of the kidney and unites the pelvis with a perirenal abscess. The medulla is comparatively much more involved than the cortex. This type of involvement was formerly explained on the grounds that the infection of the kidney came from the bladder by ascending the ureter. The destroyed pelvis and calices, with the immediately contiguous parenchyma, is composed of caseous matter, and is shown in drawing as pale zone, c. A tubercular gland in the hilum of the kidney is indicated by b. (Mrs. M. June 15, 1901, J. H. H., natural size.)

we have seen beautifully illustrated in many specimens. There is a distinct danger of perirenal abscess, and of complete destruction of the kidney as a result of secondary infection in combination with a closed ureter. Among the types of involvement which have been described are: Tuffier's massive degen-

FIG. 283.—MASSIVE TUBERCULOSIS OF THE KIDNEY. Complete transformation of parenchyma into caseous material. Obliteration of ureter. Great thickening of capsule. Fat of sinus renalis transformed into hard, glassy fibrous material. Note large tubercular lymph glands at hilum. Sclerotic renal artery. Note likewise large size of kidney. This is the well-known massive degeneration of Tuffier. It is usually, though not always, associated with closed ureter. (Autopsy, 1553, J. H. H.)

eration; fatty sclerotic, pyonephrotic, hydronephrotic; cystic kidney; involvement of one part of a double kidney; radial involvement along the blood-vessels, or of one apex of a kidney pyramid.

Tuffier's massive degeneration (Fig. 283) represents an end stage of kidney tuberculosis. The ureter may be open or closed, but if open there is sure to be some blocking within the pelvis. This form is not found where there is active secretion from the kidney. A kidney undergoing massive degeneration presents a lobulated appearance, similar to a cystic kidney, but

the walls are thick, dense, opaque, with average thickness of $\frac{1}{2}$ cm. There are extensive adhesions, as a rule, to the fatty capsule, and the kidneys are from three to five times the normal size.

Fatty sclerotic kidney represents another end transformation of tuberculosis, the kidney being entirely destroyed, shriveled up, frequently calcified and in some cases entirely transformed into a calcareous mass, while the capsule is adherent but rarely shows marked change, except in diminution of size. Palpated from the abdomen, these fatty, sclerotic kidneys may give a false idea that the kidney is normal. We have palpated such, in which the total mass of kidney and fatty capsule entirely approximated that of a normal kidney, and exactly agreed with it in shape.

With closure of the ureter tremendous pyonephrotic processes may develop in the kidneys, either with or without secondary infection. In cases where secondary infection is present, however, the kidneys attain a greater size and produce more pronounced symptoms. Pyonephrosis is usually associated with extensive abscess formation in the parenchyma of the kidney, and with a large pyonephrotic pelvis in communication with the abscess in the cortex (Fig. 284). The entire kidney may be destroyed in this way, all the cavities opening together, or the disease may result in a rupture of the capsule, with large perirenal abscesses in addition to the pyonephrosis.

A large hydronephrosis, due to tuberculosis of the kidney, is rare, but our specimens show a few cases of a mild form, where the disease was in an early stage with tuberculous involvement of the ureter. One came to us some years ago from Dr. Vineberg, of New York, who later operated upon it. Tuffier and Klippel have described large sacculated kidneys filled with clear fluid, attributed to a preceding caseous destruction of the kidney, with a washing out of all caseous matter through the ureter, and then a blocking of the same, filling the kidney pelvis with clear fluid.

Cystic kidney may result from an involvement and closure of collecting tubules near the apices. F. Curtis and V. Carlier give an interesting case (*Ann. d. mal. d. org. génito-urin.*, 1906, xxi, 1) in which there was a cavity in the upper pole of the kidney, the apices of the lower pyramids being involved in such a way that there resulted a cystic transformation of the entire lower pole. The cysts varied in size from 2 to 3 cm. in diameter, the entire kidney presenting the appearance of one congenitally cystic. We quote one from our own records (Fig. 285):

C. N., aged forty-nine, had had throbbing attacks of pain in the right side and back for four years, some increase and frequency of micturition, and some pain on voiding. Urine normal, except for a trace of albumin and some casts.

FIG. 284.—TUBERCULOSIS OF KIDNEY AND URETER. Typical complete destruction of kidney and its transformation into caseous masses and broken-down caseous material forming caverns. The condition of the ureter is indicated by the transverse section. The upper three show lumen filled with caseous material except for a narrow slit near center. In lower four there is partial fibrous transformation; in some cases this leads to transformation of ureter into a solid cord. This type of ureter is mostly associated with early destruction of the kidney. In this case, however, the contents of caverns must have washed down before closure. (Miss E., May 25, 1906; $\frac{1}{6}$ natural size.)

Ureter of right side closed, left side doing all the work. Operation revealed a cystic kidney, so closely resembling a congenital cystic kidney that, before removing it, we explored down to the other kidney and found this normal in size and shape. The entire kidney cortex was studded with cysts, varying

FIG. 285.—TUBERCULOSIS OF THE KIDNEY WITH CYSTIC TRANSFORMATION OF UPPER POLE.
Caseo-cavernous degeneration of middle portion and normal lower pole. The drawing to left shows the appearance of posterior aspect of kidney. The drawing to the right shows longitudinal section. The cysts at upper pole were filled with clear fluid. (C., Dec. 31, 1898, natural size.)

in size from a pinhead to 4 cm. in diameter; a considerable medullary portion of kidney apparently normal still intact. Pelvis was dilated, one of the cavities communicated with it, but most of the cysts were entirely separate from the pelvis. Cysts thin-walled and filled with clear fluid. On examination, definite tuberculous processes found in walls of some cysts, and cyst wall apparently made up of new-formed fibrous and compressed renal tissue.

Tubercular Kidneys with Double Ureters. This division is of great interest and demands special attention. We had a good case where the patient had a normal second kidney, the tuberculous one being double, with an entirely different blood-supply as well as a double ureter and pelvis. The upper half was completely destroyed by an infiltrating form of tuberculosis, its ureter being closed, while the lower portion showed a normal kidney and a normal ureter. Such a case would lend itself admirably to an attempt at resection of the kidney (Fig. 281). Albarran reports an autopsy finding where one-half of the kidney, one ureter, and the bladder were tuberculous, the other half of the kidney and the other ureter being seemingly normal, and Lennander has operated on a horseshoe kidney where tuberculosis was limited to one pole.

Curious forms of distribution of tubercles along the course of a given blood-vessel are sometimes observed. Tilden Brown has extensively described a case showing this.

Somewhat similar are cases where, with two poles comparatively normal, a broad band of tuberculosis is present along the middle of the kidney, producing a kind of girdle, well defined as the girdled or belted kidney (Fig. 295).

We have said it is not unusual to find the apices of the pyramid involved, leading to extensive hemorrhage. There was definite destruction of the apex of one of the upper pyramids in one of our cases, and similar cases have been described by Israel and others (Fig. 292).

Involvement of Ureter in Tuberculous Kidney.—Of course, as will be pointed out later, it is possible for a thickened ureter to be present and the thickening not to be due to tuberculosis, though in no less than fifty-two specimens out of fifty-three of which we have accurate notes, this thickening of the lower end of the ureter was present. The tuberculosis is usually diffuse, involving the entire length of ureter, but the most important parts of it which suffer particularly are: first, the vesical, and, second, the pelvic end. Thirty-one specimens, in which we have the ureters as well as the kidneys, all showed tuberculosis of the lower end, and out of these, fifteen had tuberculosis distributed all through the course of the ureter, while in eight there were only a few tubercles here and there.

In addition to definite tuberculous change, there is an inflammatory reaction of an interesting nature, limited to the mucous membrane. In nearly every case of tuberculous kidney there is a marked round-celled infiltration of the tissue immediately underlying the epithelium of the mucosa of the ureter, a change frequently present when there is no sign whatever of either tubercle bacilli or of tubercles, and which, in many cases, has been diagnosed as chronic

FIG. 286.—TUBERCULOSIS OF KIDNEY AND URETER. Note wide lumen of lower part of ureter and choked condition above. Note extensive involvement of calices and pelvis, where disease seems more advanced than in cortex. At lower pole there is still a little normal cortex. The wide-lumened ureter is due to the fact that after caseation of its inner coats, the down-pouring urine washes out a channel. If the renal parenchyma holds out long enough, the entire ureter may thus be opened. For such a condition a secretory kidney is essential. (Miss G., May 1, 1906; $\frac{3}{4}$ natural size.)

ureteritis by the pathologist. It seems to be due to the irritation of some toxin present in the urine, derived from the tubercle bacillus itself or from the altered kidney tissue. The blood vessels in the mucous membrane are usually dilated, with occasional polymorphonuclear leukocytes and round cells in the stroma. This change is met with in pure tuberculosis without any secondary infecting organisms. When tubercles develop, they always begin in this same layer and involve first the mucosa and then the muscularis of the ureter, also there is usually present a periureteral inflammation which results in the adherence of the ureteral sheath to the ureter.

The process, beginning with miliary tubercles, which increase in number, fuse together, and caseate, generally continues on to the formation of ulcers along the ureter, with stricture as a not uncommon result, especially at its lower end. In other cases the ureteral lumen may be actually plugged with caseous matter, a likely happening if the kidney is destroyed above and functionless. With an actively secreting kidney above, the débris is likely to be washed through; then ensues such destruction of the ureter that all normal coats are destroyed, the fibrous sheath practically forming a ureter, with a very widely dilated lumen (Figs. 286 and 290). These giant ureters, according to Hallé and Motz, are particularly likely to occur where there is secondary infection. That small

FIG. 287.—TRANSVERSE SECTION OF THE URETER. The thicknesses of the several coats are in the proportions shown. Note fibro-fatty envelope. Magnified 6 times.

ureters do not occur in cases with marked secondary infection conforms with our experience.

Four stages are given by Hallé and Motz (*Ann. d. mal. d. org. génito-urin.*, 1906, i, 162; 241): (1) The mucosa alone is infected, the ureter always a little dilated; (2) The lumen is filled with tubercular and caseous material; (3) A new lumen is made by the breaking down and washing out of tissue; (4) A transformation of entire ureter into a fibrous cord (an unusual and very late change presented by only one of our specimens). The types of ureteral changes are beautifully shown in Figures 284, 286, 287, 288, 289, 290 and 291.

It is through the urine that the tubercle bacillus involves the ureter in the majority of cases. It is carried down from the kidney and implants itself directly on the mucous membrane, and there produces its typical change.

SYMPTOMATOLOGY

Essentially a chronic disease, with the exception of the miliary form, tuberculosis of the kidney may run a course of many years if not interrupted by

FIG 288.—EARLY TUBERCULOSIS OF THE URETER DUE TO TUBERCULOSIS OF THE KIDNEY.

Drawing to the left represents transverse section of the ureter magnified six times. The transverse diameter of the ureter is of normal length. The muscular and fibrous coats are normal. The lumen is somewhat narrowed, due to thickness of mucosa which is tubercular. The little square marked by arrow is magnified 30 times in drawing to right. Note that surface epithelium is destroyed. Two tubercles with giant-celled centers are shown. Note marked infiltration with small round and polymorphonuclear cells, in this case extending through muscular coats and to a lesser degree through the fibrous coat.

surgical treatment. A few cases, to which we will return later, heal spontaneously after complete destruction of the kidney involved by occlusion of the ureter. A good illustration of the chronicity of the disease is the fact that the average symptomatic period in our own cases is three and a half years.

In some cases the process moves far more rapidly; within a few months after the first onset of symptoms, the entire kidney may be destroyed, the other one possibly diseased, and the bladder thoroughly so. This rapid course was well illustrated in one of our cases.

G. B., an unmarried woman of 24, consulted us in September, 1905, having had for a few months mild symptoms suggestive of cystitis. Tubercle bacilli were discovered in urine from right kidney. The resident at the Johns Hopkins Hospital, planning to do a nephrectomy, exposed the kidney but found it so

FIG. 289.—MORE ADVANCED STAGE OF TUBERCULOSIS OF THE URETER. Entire mucosa destroyed. Most of the muscle coats destroyed and replaced by caseous material. The lumen of ureter is filled with same material. The deeper muscle layers are infiltrated with typical tubercles. The fibro-fatty sheath has become densely adherent to ureter and forms, as it were, its outer coat. It is the addition of this coat which gives the great increase in thickness of ureter.

normal in appearance that he did nephrotomy, and found no evidence whatever of disease. His operation gave no relief and the symptoms increased in severity. She returned six months later, the kidney was removed, and there was not the slightest amount of active renal tissue left, as shown by microscopic examinations of the removed organ. Note, too, that this destruction was accomplished by the unaided influence of the tubercle bacillus, for the bacteriologic examination showed we were dealing with a pure tuberculous infection.

Symptoms arising from tuberculosis of the kidney are various. It is convenient to classify them into several groups: (1) General manifestations, such as loss of weight, chills, sweats, fevers, etc.

FIG. 290.—STILL MORE ADVANCED STAGE OF TUBERCULOSIS OF THE URETER. An actively secreting kidney above has washed down the caseous and infiltrated tissue shown in preceding figure. The original ureter may be entirely destroyed, a new channel being formed by the old fatty fibrous sheath which has become a dense, hyaline fibrous tissue. Such a ureter seems greatly enlarged.

(2) Development of pain or tumor in affected kidney; of sensitiveness and all symptoms elicited by palpation.

men

FIG. 291.—HEALED TUBERCULOSIS OF THE URETER. This represents a still more advanced stage than the preceding figure. The fibrous sheath has shrunk and the lumen been obliterated by fibrous tissue. No evidence of original tubercular process appears.

(3) Disturbance of bladder; frequency of and pain in micturition; incontinence of urine, strangury, etc.

(4) Alteration in character of urine, caused by the appearance of pus, blood, or cloudiness; malodors are occasionally complained of by patient.

General Symptoms.—Just a word on general symptoms before taking these groups up in order. It is striking how, with severe renal tuberculosis, the general condition of a patient may for a long time be unaffected. Only recently this was shown in the case of a minister, a man of fifty years of age, who came to us, as the operation disclosed, with congenital absence of the left, and advanced tuberculosis of the right kidney, associated with stones in its pelvis. With marked vesical distress, and kidney symptoms for many years, he was yet in an active state of health, and stated that he had lost no weight. So good was his general condition that it was difficult to believe that he had only one kidney and that tuberculous.

Out of one hundred cases only twenty-five of our patients were in pronouncedly bad condition as far as nourishment and strength went. In 30 per cent. of these patients the condition was noted as robust; in 40 per cent. as only fair. Forty-two per cent. gave a history of chills, fevers, and sweats; the other 60 per cent. had had none of these symptoms. We found those cases presenting most marked evidence of general ravage from disease to be those with pyonephrosis, either of the pure tuberculous type or with secondary infection. In the presence of such large abscesses, the sufferers have high fever, exhausting sweats, and rapidly lose flesh. Such patients often come into the clinic apparently almost *in extremis*. It is wonderful how rapidly they pick up after the drainage of the abscess by nephrotomy. Most patients with tuberculosis of the kidney show elevation of temperature. This was observed in 70 per cent. of our list. Where the ureter is open and consequently there is damming back of infecting matter, the temperature is usually only a degree or two above normal in the afternoon, but not always, for fever in kidney tuberculosis is very irregular. Unless secondary infection is present, this fever is not accompanied by increased polymorphonuclear leukocytes in the blood. But with secondary infection there may be marked leukocytosis. While the temperature in some cases is almost continuous, in others there is sometimes a morning rise and an evening fall.

Anemia is a frequent though not striking complication. In one of our cases the hemoglobin was only 33 per cent. The average hemoglobin, however, was 75 per cent., almost average adult normal.

Symptoms Referable to Kidney.—A striking characteristic of kidney tuberculosis is the frequent absence of local symptoms referable to the kidney itself. In this it stands in contrast to most other renal affections.

TUMOR.—We have never had a patient come in complaining of a mass in

the side as her chief symptom, although in twenty-two the kidney has been so much enlarged that palpation readily demonstrated such a mass. That tumor, however, can occasionally occur as the only symptom and the cause of the patient's consulting the physician is well recognized. Viannay (*Indépendance méd.*, 1901, Nr. 18) gives an excellent example. Without any previous symptoms a tumor developed in a patient's side and reached the size of a man's head. Its appearance, the absence of all symptoms from the urinary tract, and the negative findings on examination of the urine, led him to diagnose a pancreatic cyst, but the operation disclosed a tuberculous kidney containing 400 c. c. of pus.

PAIN IN THE KIDNEY.—Pain occasionally occurs as the only, and frequently as the principal symptom of tuberculosis of the kidney. It varies markedly in its character. In some cases it is merely a dull ache in the lumbar region, in others it comes in paroxysmal attacks of renal colic, in no way differing from those occasioned by the passage of a stone down the ureter.

As to the frequency of pain in comparison with the other symptoms and its importance, we quote concerning sixty-two cases: In only six was the sole symptom of the disease pain in the kidney. In twenty-two, from beginning to end, the symptoms were those of cystitis, and the patient was not in the least conscious of any kidney disturbance. In sixteen, associated with marked irritability of bladder, there was a dragging, distressing sensation in the kidney region; and in seventeen, with bladder disturbance, a history of paroxysmal attacks of renal colic. These cases with occasional attacks of pain are frequent, and often give a history of several years' duration. It is worthy of note that of the six cases where the sole symptom was pain, the pain was paroxysmal in four and in two a constant dull ache. As already pointed out, pain with kidney tuberculosis usually starts in the kidney, and though in most cases it does not radiate, it may run along the course of the ureter, and we have had instances where there was radiation to the opposite kidney, or to the shoulder-blade.

The attacks of colic are rarely so severe as those which accompany stone in the ureter, and in the early stages are dependent, no doubt, upon swelling of the mucous membrane of the kidney pelvis and the ureter from inflammatory reactions. In the later stages such attacks can be brought about by the passage of bits of caseous matter or blood clots through the ureter, and, not infrequently, by the passage of pieces of calculus, for, as will be shown a little later, the concurrence of tuberculosis and renal calculus is common.

Bladder Symptoms.—It is of the highest importance that we should recognize marked vesical disturbance as the commonest, in fact almost the characteristic, symptom of renal tuberculosis. As stated in the introduction, Howship

(1823) saw this, and almost every writer on kidney tuberculosis has referred to it. It is this vesical irritability, as either the sole or the predominating symptom in the clinical picture, which so frequently leads the practitioner astray and involves the patient in a long course of painful bladder treatments yielding no result.

The importance of irritability of the bladder as a symptom of kidney tuberculosis cannot be overestimated. At least 90 per cent. of our cases presented it alone or in combination with other symptoms, while in 70 per cent. it was the initial symptom.

CAUSE OF VESICAL SYMPTOMS.—In many cases frequency of micturition and painful micturition associated with tuberculosis of the kidney are due to involvement of the bladder by the tuberculous process. In many instances, however, marked vesical distress is met with where cystoscopic examination shows a healthy looking bladder. Many explanations have been offered to account for this, the commonest being perhaps that of a reflex nervous phenomenon. This reasoning seems weighty from the fact that disturbances of the bladder are so frequently associated with kidney colic and with diseases of the rectum. We have noted in several patients that this irritability occurred when the ureter was completely closed, the kidney functionless, and the bladder normal. In spite of this, we incline to the view that the chief reason lies in irritation caused by the urine. Reddening and irritation of the bladder are frequently observed where there is a tuberculous kidney, which immediately disappear when nephrectomy is done. This irritating character of the urine has been noted in describing the pathology of tuberculosis of the ureter. It is well to bear in mind, however, that these vesical symptoms without involvement of the bladder do not compare in severity with those present when the bladder also is involved in the disease.

INCONTINENCE.—The first bladder symptom is urgency in voiding. This may at first occur only during the working hours, but is soon felt at night. Georges Constantinesco (*Jour. d'urol.*, 1912, i, 611) has drawn particular attention to the frequency of incontinence of urine and notices that it may be associated with either unilateral or bilateral tuberculosis and is mostly nocturnal.

In extreme cases the patient is compelled to pass urine almost continuously. We have had many who have slept with bed-pans and other arrangements as necessities.

PAIN.—The accompanying pain develops later and is usually most severe at the time of voiding. Sometimes it is described as following micturition, but generally it precedes or accompanies it. This pain is variable in inten-

sity, it may be a mere tickling sensation scarcely noticeable, or an extreme strangury. It is no unusual sight to meet with a patient who actually screams with pain at every voiding, a condition well understood when one realizes that the voiding may occur every hour and take fifteen minutes. In addition to the pain on micturition there is frequently marked constant pain in the bladder. It is common in the male subject, where the prostate gland is involved, to have severe pains in the perineum and in the urethra, especially at its end; also burning pain at the end of the urethra which follows micturition and which is so common with stone in the ureter. It is much more uncommon to have pain in and around the perineum in women, but we have seen one case where there were severe attacks.

IMMUNITY OF THE BLADDER.—That it is possible for the bladder to remain free from tuberculosis even when considerable amounts of blood and tubercle bacilli are passing over it, is well illustrated by one of our cases in which the principal symptom was marked hematuria. In this instance there was pulmonary tuberculosis with neither bladder nor local kidney symptoms. The catheterization of one kidney showed that tubercle bacilli, as well as blood, were coming down in large numbers. The kidney removed by operation showed the tuberculosis to be limited to the apex of one of the pyramids coming from the upper pole, and the rest of the kidney was normal (Fig. 292).

Polyuria.—Polyuria, noted as present in the early stages of the disease, and especially urged as characteristic by Tilden Brown and by Guyon, seems, nevertheless, to have no particular significance as a symptom, and certainly is not present in the majority of cases. It is often pronounced in miliary tuberculosis, and the idea of its frequency is no doubt accentuated by the accompanying urgency of micturition. The underlying cause is not clear; it may possibly be due to interstitial nephritis set up by the disease, which is a constant accompaniment of tuberculosis (see Pathology). Cystoscopic studies have impressed us with the frequency with which the tuberculous kidney can secrete a greater volume of fluid than its healthy fellow, although in these cases it must be borne in mind that the total amount of solids is less from the diseased than from the normal kidney.

Changes in Urine.—In describing a case of hematuria we pointed out that blood may be the first and potent cause of a patient's coming to a physician, and it is not an infrequent accompaniment of other symptoms. Out of one hundred cases 25 per cent. complained of having passed blood. In only two, one of which was the case quoted, was the amount of hemorrhage great. The patient will generally say she has noted small amounts of blood in the urine for a few days, and then comparative clearness for quite a period. Cer-

tain authors have noted that cases with marked hematuria are associated with disease in the apex of a pyramid. The reason for the hemorrhage in these cases is readily understood by remembering that the pyramid is surrounded by a vascular network of anastomosing veins, which would readily be opened by marked disease in the papilla (Fig. 209). But extensive hematurias occur when the disease is located in other parts of the kidney, of which Tuffier (*Comp. rend. Soc. biol. de Paris*, 1892, iv, 511) reported a good case in 1892, the tuberculous foci consisting of six cavities in the parenchyma. Schlesinger also gives one of severe hemorrhage in a patient who died of pulmonary tuberculosis, where the autopsy showed nothing save a few tubercles situated in the kidney pelvis. This case would seemingly need to be classed with essential hematurias, and perhaps depended upon some focal interstitial nephritic change. This hemorrhagic form has been described by Israel, Pousson, Albaran and others.

Only less marked in its influence on the patient is turbidity. Very turbid urine may be constantly present, or only attract attention now and again, but it is rare for no change whatever to be noted.

F. H., a woman of 47, came to us complaining of throbbing attacks of pain in right side and back, which had been present for four years. Urinary examination showed merely a trace of albumin and a few hyalin casts; palpation disclosed a body in right side which felt like a cyst. Cystoscopic examination revealed one ureter secreting normal urine, the other none whatever. Bladder normal. Operation disclosed a cystic kidney, described fully under Pathology.

It is not uncommon also for the urine to be normal for a certain period, due to temporary occlusion of the foci of disease, but this point will be better dealt with under the section Examination for Pus.

Summary.—To sum up, in an average case, there are:

- (1) Vesical distress, possibly some pain in the side;
- (2) Occasional fever;
- (3) General condition fair;
- (4) Blood and perhaps turbidity in the urine.

There are, as said, exceptions. Tuffier recently reported a series of cases where marked pain in the kidney was the characteristic symptom.

Rafin (*Jour. d'urol.*, 1912, i, 779) has studied the initial symptoms in 160 cases with the following result:

- Vesical symptoms, 61.87 per cent.;
- Kidney symptoms, 19.37 per cent.;
- Hematuria, 5 per cent.;
- Turbidity of urine, 2.5 per cent.;

Albumin, 1.8 per cent. ;
Renal pain and hematuria, 2.62 per cent. ;
Vesical pain and hematuria, 1.87 per cent. ;
Loss of general strength, $2\frac{1}{2}$ per cent. ;
Indeterminate, 4 per cent.

DIAGNOSIS.

A careful clinical history is the first indispensable step to correct diagnosis. Every patient complaining of bladder symptoms should be carefully interrogated with the possibility of tuberculosis of the kidneys in mind. The physician must first determine whether the condition is tuberculosis, and, having determined this, must then find out its location and extent. Is one or are both kidneys involved? Is the bladder involved? Is there tuberculosis in other parts of the body? If the tuberculous process is limited to one kidney, is the other kidney perfectly healthy? While diagnosis is comparatively simple in those cases with blood, pus, and tubercle bacilli in the urine, it may be extremely difficult in early cases where none of these abnormal elements are demonstrable.

The first step is to demonstrate that tuberculosis of the urinary system exists, and the one positive proof is the presence of the tubercle bacillus in the urine. Bear in mind that there are other findings which render the probability of tuberculosis very great and which in some cases form the basis of complete diagnosis: e. g., a chronic acid cystitis which has started insidiously and resists all ordinary medicaments is highly suggestive of kidney tuberculosis, still more so when there is evidence of tuberculosis elsewhere in the body. In our series of cases there was evidence of tuberculosis elsewhere in only 30 per cent. ; of these, 50 per cent. showed pulmonary involvement, 20 per cent. involvement of the genital organs, 15 per cent. of the lymph glands, 15 per cent. of the joints and bones.

Palpability of Kidney and Ureter.—Added to careful observation of the temperature curve and of the leukocytosis, palpation of the abdomen in tuberculous kidney is of importance. From what has been said of the frequency of kidney enlargement, it is evident that tuberculous kidneys are far more frequently felt to be enlarged than those in patients who have no tuberculosis. In cases where pyonephrosis has developed or perirenal abscess, there may be great masses in the kidney region, but in the majority the kidney, while enlarged, is not sufficiently so to be found by ordinary abdominal examination. (Other methods are described under the general chapter on Examination.)

Only 35 per cent. of our cases had palpable or enlarged kidneys. When the kidney is palpable, as in a recent case of movable kidney associated with tuberculosis, the irregular form was readily made out. The tuberculosis was limited—as shown by examination of specimen after operation—to the middle zone of the kidney. This resulted in an irregular shaped nodular mass, not at all corresponding to the usual bean shape of a normal kidney. It is uncommon to produce the so-called “kidney bladder reflex” by palpating tuberculous kidneys, but occasionally forcible palpation of a tuberculous kidney will produce a pain which radiates down from the kidney along the course of the ureter.

Thickened Ureter.—A sign which we have found of the greatest assistance in diagnosis is the discovery of a thickened, tender ureter by vaginal examination. The technique of examination is shown in Figure 115. The index finger can feel the enlarged ureter passing through the parametrium. The ureter in some cases may be simply hardened and about the shape of a lead pencil; in others it is actually nodular, and the reflex described by Bazy (pressure on the ureter causing a desire to empty the bladder) is almost invariably present.

Thickening of the lower end of the ureter is a most common accompaniment of renal tuberculosis, occurring in 75 per cent. of our cases. Similar thickenings are present with stones in the lower end of the ureter, and with strictures due to ordinary infections. The mere discovery, therefore, of a thickened ureter is only highly suggestive. In some cases a thickening of the ureter does not mean tuberculosis of the kidney, even where there is an actual tuberculosis of the urinary tract. We have had two patients in whom, with tuberculosis in one kidney and simple pyelitis in the other, the pyelitic ureter was as thickened as the tuberculous.

A discovery of tubercle bacilli in the urine and a thickened ureter on one side, with a normal feeling ureter on the other is in most cases sufficient to justify the removal of the kidney with the thickened ureter, but that this may lead to evil consequences is certain. The following case illustrates this point:

M. F., a woman aged 26, had a small, contracted, and completely tuberculous bladder. Right ureter not palpable, but left thickened and tender. It was found impossible to catheterize the ureters. An exploratory laparotomy showed what appeared to be a right kidney of normal size, but a greatly enlarged left one. The left kidney was, therefore, removed, and this patient died of complete anuria. A pathological examination showed the kidney removed to be a compensatorily hypertrophied one, with acute miliary abscesses of pyogenic origin scattered throughout its entire cortex, while the other was a fibro-sclerotic tuberculous mass from which all renal tissue had disappeared. The normal

shape and size felt by the laparotomy were given to the kidney by its fatty capsule.

Tuberculin.—Tuberculin is of distinct value in the diagnosis of kidney tuberculosis. Carefully employed it is without danger and frequently gives positive evidence of the disease not obtainable without it. The skin and ophthalmic reactions are of much less value than the old hypodermic method, because, even when positive, they do not point definitely enough to the kidney. They are also frequently negative, when there is tuberculosis of the kidney. By the hypodermic method, although it also fails to react in some cases positively tuberculous, the results are more satisfactory. We are in the habit of taking the temperature every two hours for twenty-four hours, and then giving the patient one milligram of diagnostic tuberculin. If there is no reaction to this, the next night a dose of three milligrams is given. The temperature should then be taken every two hours for thirty-six hours. When positive, there is a distinct rise in temperature, usually at the end of eighteen hours, and the patient is likely to feel badly for a day or two, with general malaise. We have observed no permanent ill results, however, from such doses. Frequently, in addition to causing pyrexia, it will set up pain in the affected kidney and irritation of the bladder. Often, where they have not been demonstrable before, there is a throwing down of tubercle bacilli in the urine during a positive tuberculin reaction.

Urinary Examination.—Under Pyuria the significance of pus in the urine without any vesical symptoms has been discussed at length, such pus almost always coming from one or both kidneys. Exactly the same thing is true of blood. It must be remembered, however, that the presence of vesical symptoms does not necessarily mean that the abnormal element comes from the bladder, for, as said before, a tuberculous kidney may create a great deal of vesical pain and irritation without there being any bladder tuberculosis. The first and most important step in a suspicious case is the demonstration of tubercle bacilli in the mixed urine.

THE TUBERCLE BACILLUS IN THE URINE.—The demonstration of the tubercle bacillus in the urine clinches the diagnosis of urinary tuberculosis, and, from what we have already said as to the character of urinary tuberculosis, it is positive evidence that one or both kidneys are involved. Owing to the fact that the smegma bacillus takes the same stains as the tubercle bacillus, it is useless to examine voided urines. It is always imperative to obtain catheterized specimens. This simple point in technique is frequently overlooked and very often leads to serious diagnostic errors. Hardly a season passes without a case or two being brought in to us with a positive diagnosis of tuberculosis of the

kidney when the real cause is something else, the smegma bacillus having confused the examiner. The finding of tubercle bacilli in the urine means both kidney and bladder involvement in some cases; in others, kidney alone. A complete diagnosis is only reached by catheterization of the ureters and examination of the urine of each kidney separately.

The methods of demonstrating the tubercle bacillus in the urine are similar to those used for other fluids. They are either demonstration of the organism on smears or the production of the tuberculous process in guinea pigs by injecting the suspected urine into their subcutaneous or peritoneal tissues.

Smears.—As staining reagents, nothing is superior to the well-known saturated aqueous solution of carbol fuchsin and Gabbot's methylene blue. The smear, which has been dried in the air, is fixed by passing it through the flame of a Bunsen burner. The carbol-fuchsin is added and allowed to steam for two minutes, the fuchsin is then washed off in running water, and Gabbot's methylene blue added until all the red color has disappeared, one minute as a rule sufficing for this. When present the tubercle bacillus will be shown as a red staining body, slender and usually in clumps. The staining is a little irregular, giving the organisms a beaded appearance. The pus present, as well as contaminating organisms, will be stained blue in these preparations.

Recently marked improvement has been made in the method of centrifugalizing the specimens from which the smears are made. Our own technique for years has been to take a well shaken-up specimen, thoroughly centrifugalize it, and make smears from the deposits in the bottom of the centrifugal tubes—the pus present serves as a fixative on the slide. This method is of no value in cases of excretion of tubercle bacilli through healthy kidneys, for the tubercle bacillus is of less specific gravity than the urine and will not sedimentize. In such examinations better results should be obtained by employing Loeffler's method, which consists in adding chloroform to the urine, shaking up well, and centrifugalizing. The chloroform combines with the tubercle bacillus and greatly adds to its weight. The smear is made from the stratum of urine which lies just above the chloroform. In very purulent urines, especially where other organisms are present, it is of advantage to employ the full Loeffler method, which is, to add antiformin to the urine, thus dissolving the pus and formed elements with the exception of the tubercle bacillus, after which the urine is mixed with the chloroform, as already described. O. H. Forsell has described a method by which he is able to centrifugalize very large amounts of urine, even twenty-four-hour quantities, and believes that he discovers organisms if they are present. Undoubtedly some cases of surgical tuberculosis where abscesses are inclosed in the cortex are not associated with tubercle

bacilli in the urine; such, however, are certainly exceptional. In 62 cases, where carefully looked for, we found tubercle bacilli 34 times. It is of advantage to look for the organisms repeatedly and in different specimens; it may happen that they are absent from the urine one day and appear the next.

The Guinea Pig Method.—This procedure is very delicate for urines which contain no pus. It is with difficulty applicable to urines containing secondary infecting bacteria, because the animal is so likely to die from the pyogenic infection. In cases of pure tuberculous infection it is very delicate but has the disadvantages of costliness and slowness in development.

A healthy animal should be obtained and always preliminarily tested with tuberculin. We have obtained our best results by subcutaneous injection, although many prefer intraperitoneal. The abdomen should be shaved and cleaned and three or four c. c. of the suspected fluid injected with an ordinary hypodermic syringe. In from two to three weeks there will develop definite tuberculous tissue, both at the point of inoculation and in the contiguous lymph glands. Considerably more certainty is added to the glandular involvement by traumatizing the inguinal and axillary region at the time of the injection. This can be done by pinching and bruising them. A satisfactory method of demonstrating the disease is to grind up the tissue, treat with antiformin until digested, then to centrifugalize and stain the sediment for tubercle bacilli.

OTHER PATHOLOGICAL ELEMENTS.—In addition to the specific organism, pus and blood are almost constantly present in the urine, and in many cases other bacteria and frequently casts, as well as epithelial cells.

Pus in Urine.—This can be reckoned on as always present, although the amount may vary enormously, and we have found it in 98 per cent. The cells are mostly polymorphonuclear, that is, 90 to 95 per cent. are so, while 5 to 10 per cent. are mononuclear. Many efforts have been made to diagnose tuberculosis by the character of these cells, and one of the most recent workers in this direction, S. Colombino, observed in a series of cases with tuberculosis that the leukocytes were extremely irregular in shape and size, and the nuclei were not so clearly stained as when they arose from some other pathological process than tuberculosis. He noted, too, that the nuclei are often found outside the cells. J. Moscou (*Presse méd.*, 1907, xii, 9) has more or less confirmed the work of Colombino. Since the publication of Colombino's work (*Ann. d. mal. des org. génito-urin.*, 1906, xxi, 81) in January, 1906, we have attempted substantiation, but have not been successful. In our experience the cells are just as normal and as well preserved in tuberculous genito-urinary cases as in those due to other organisms. The irregular cells which he describes do sometimes occur with chronic tuberculous conditions of the bladder and

kidneys, but are also met with in other chronic affections. Many text-books state that a large number of mononuclear cells are characteristic of tuberculosis, but this is not in accordance with our findings.

Red Blood Cells.—In association with pus red blood cells are nearly always present, usually in microscopic amount, but not infrequently hemorrhage is extremely abundant and may be the most marked symptom. Such was the case of Miss S., a patient who had a tuberculous process located in the apex of one papilla of the upper part of the kidney (Fig. 292).

Under Symptoms we have pointed out that *macroscopically* blood was observed in only 40 per cent. of cases; but it was found *microscopically* in practically every case where pus was present.

Secondary Organisms.—Involvement of the bladder and kidney by other organisms than the tubercle bacillus is liable to take place at any time in the course of the disease, though not so frequently as some would lead us to believe. In our series only 17 per cent. showed secondary infection, the organism in every case being the colon bacillus. There is no reason, of course, why other pus formers should not be associated, and such cases have been described repeatedly in other case reports. The presence of the secondary organism in no way changes the symptoms, although pyonephroses are more

FIG. 292.—TUBERCULAR KIDNEY. Disease limited to solitary focus in lowermost papilla. Hematuria was the primary and characteristic symptom of this case, due to injury of numerous vaso-recti, after destruction of papilla. (S., Nov. 23, 1899; natural size.)

liable to develop, a fact likely to complicate diagnosis considerably, for the tubercle bacilli were demonstrated in only 30 per cent. of this group of cases. The amount of pus with a pure tuberculous infection may be quite as great as that with a mixed infection. The presence of secondary organisms can be demonstrated on the slide with catheterized urine, and their exact nature is best worked out by getting a culture of the bladder urine.

Casts and Albumin.—The great frequency of these in the urine is easily understood in face of the pathological processes induced by tubercle

bacilli. We refer to the focal interstitial nephritides. Many sections of tuberculous kidney show hyalin and sometimes granular casts lying within the tubules, and it is not uncommon to observe these in the urine during life, while a kidney which is not tuberculous may be the source of some casts (see Indications for Operation). Five of our cases showed no tuberculous process, but casts and albumin were in the one kidney and tuberculosis in the other. With tuberculous kidney there is frequently an excessive amount of albumin in the urine, but this subject comes under the chapter on Urinary Analysis.

CULTURAL METHOD OF DIAGNOSIS.—When urine contains a large amount of pus and neither on cover slip nor on agar culture any bacteria are found, the probability is greatly in favor of the disease being tuberculosis. A small amount of pus, however, simply indicates a gonorrheal infection. These gonococci, like tubercle bacilli, are difficult to demonstrate and do not grow at all in the ordinary cultures. Very occasionally, also, pyurias are due, as in one of our cases, to an anaërobic organism which does not grow on ordinary media; the distinction from tuberculosis, however, is clear, as the cover slip shows this organism in the urine in large numbers. Out of forty-eight consecutive cases in which we took cultures, thirty-seven showed no growth on agar. An abundant acid pyuria without any organisms discoverable is, therefore, one of the most suggestive signs of tuberculosis we have.

Cystoscopy.—The methods of examination hitherto described are such as serve to establish a tuberculosis of the urinary tract, but do not show us just what is its location, nor distinguish between bladder and kidney tuberculosis, nor show if either kidney is healthy. It is possible, however, in many cases, by a consideration of the history, by the feeling of the ureters, and by tuberculin results to locate the disease in one side or the other, a decision finally and exactly arrived at by cystoscopic examination, catheterization of the ureters, and examination of the separated urines. The cystoscope at once reveals the bladder as involved or not so; and also shows the site of involvement. The appearance of marked tuberculosis around one ureteral orifice while the rest of the bladder is normal suggests very strongly a diseased kidney above it, and such a finding is quite common. In 50 per cent. of our series there was marked tuberculosis about the ureteral orifices; in 15 per cent. the disease was about both orifices, but in half of these, as subsequently shown, the disease was limited to one side. In eleven, where there was only slight tuberculosis around a single orifice, this orifice was invariably that of the diseased side. Exceptions to this, however, are met with, and a case from the late Wm. Pryor aptly illustrates this point. He found on cystoscopic examination of one case a left ureter surrounded by tubercles, with an apparently normal right ureteral orifice. On

catheterizing the right side, however, he found no urine being secreted, and a totally destroyed right kidney, with what was apparently an incipient tuberculosis of the left side. Note well that in certain chronic cases of cystitis, little yellowish nodules may be seen on the trigonum somewhat resembling miliary tubercles, though generally readily distinguishable from them. Bladder tuberculosis, as shown later, may be miliary or ulcerous, the latter being a later stage.

In addition to definite tubercles, retraction of the ureter is frequently met with, this so-called golf-hole or funnel-shaped ureter being frequently an accompaniment of the thickened ureter, and due to a shortening of the ureter dependent upon the tuberculous process. Hurry Fenwick reasons that within the first two years of the disease a golf-hole ureter means that the upper and lower calices of the kidney are the parts involved, the middle portion of the kidney remaining normal. He explains that it means a strictured ureter and therefore a dilatation of the pelvis; such dilatation, on account of the anatomical relations, meaning that the greatest injury is brought to bear on the upper and lower poles. The golf-hole or retracted ureter, like the tubercles around the orifice, forms a very valuable index but not a positive one, as well illustrated in one of two cases of primary bladder tuberculosis which we have had, where one orifice was indrawn and the other slightly puffy. Believing that the indrawn orifice signified tuberculosis of that side, we explored the kidney, but found a healthy organ. A nephrotomy on the second kidney showed it likewise to be normal. In neither case was there any apparent kidney involvement. After three years this patient still has two actively functioning kidneys without any evidence of tuberculosis.

Catheterization of Ureter.—To determine finally the involvement of one or both kidneys, the ureters should be catheterized. For the purpose of estimating the functional activity of each side it is enough to catheterize one ureter and collect the urine secreted by the other from the bladder. The transvesical method of collecting urine (described under Examination) we employ constantly. In addition to obtaining urine from each side the catheters are able to give information on points other than tuberculosis. Strictures of the ureter, which are often present, can be detected, the stricture most frequently found at the vesical end of the ureter being occasionally situated higher up, its frequency being manifested by the fact that out of thirty-nine cases where we have looked for it, it was present in twenty-one. The extent of such a stricture may be carefully calibrated by means of a series of graded catheters, and its bite may be tested by means of a spring with a pulley. The occurrence of a stricture at the lower end of the ureter is occasionally a very early manifestation of

tuberculosis. Two of our cases had urines apparently normal, but catheterizing showed a slight hydronephrosis and a strictured ureter of one side. They came to our clinic some years before the use of tuberculin and functional tests, and, nothing whatever being found except stricture of the ureter, they were sent out with this diagnosis. Both developed later marked kidney tuberculosis. In two or three cases by means of the catheter we have removed from ureters whose lumina were plugged with caseous matter small amounts of this substance, and have shown the disease to be definitely tuberculous by making smears on slides. Secondary infection apparently has no influence in the producing of such strictures; it was present in four out of eleven cases of this kind where other organisms beside tubercle bacilli were found in the urine.

Let there be a very definite procedure in catheterizing the ureters, owing to the possibility of carrying infection into a healthy kidney. If the bladder is not at all involved, catheterize that ureter which has excited suspicion, then wash out the bladder carefully and gather what has accumulated in it. The urine is thus collected from the two sides. When the bladder is involved and the disease is around one ureteral orifice, catheterize that ureter, wash out the bladder, and collect the urine from both sides, one through the ureteral catheter, the other transvesically. In very exceptional cases it may be necessary to catheterize both sides. A bladder thoroughly washed will show urine from a healthy kidney to be almost normal, even though it comes over a diseased bladder. The urine should be collected continuously from the two kidneys for a period of not less than an hour, and should be submitted to the bacteriological and chemical tests already noted.

Very confusing results are occasionally met with where two ureters come down from one kidney. In such a condition one-half may be discharging pus and tubercle bacilli, while the other pours out practically clear urine. It is possible, therefore, to catheterize the ureters on both sides, getting clear urine from each side, and still have tuberculosis of the kidney. An interesting case of this kind has been described by Heymann (*Ztschr. f. Urol.*, 1912, vi, 473), in which a separator seemed to show tuberculosis of the left kidney and a normal right kidney, while catheterization of the ureters seemed to show that both kidneys were normal. Nephrectomy, left, disclosed the fact that the condition was a double kidney, one-half of which was tuberculous.

Examination of the Other Kidney.—The exact state of the kidney which is not tuberculous must always be ascertained: It may be normal, it may show nephritis, or there may be a pyelitis present within its pelvis. Having obtained the urine, one can compare the secretory power of the two sides. As stated, we have found albumin and casts present several times in the opposite

kidney, and in several cases a definite colon pyelitis of the opposite side. In cases where a tuberculous kidney is doing a great deal of work, it becomes a question whether the other kidney can keep up the body economy on removal of the tuberculous one.

Functional Tests.—For the technique and value of the functional tests the reader is referred to Chapter XI. In every case of tuberculous kidney it is most important to do everything possible to gain an idea as to both the total and the comparative function of each kidney. It should be borne in mind that the interstitial changes so common in tuberculous as well as in non-tuberculous kidneys in this class of cases will interfere considerably with the excretion of the dyes. One finds in comparing the tuberculous with its fellow kidney all the variations from total inactivity to as great or greater activity than the healthy side. In cases showing general renal insufficiency it is a much graver procedure to remove an actively secreting tuberculous kidney than one which is not secreting at all. It should be borne in mind, too, that the deaths from renal insufficiency, due to nephritis, may not occur immediately after the operation, but within a year or so. A factor to be considered, too, is that the second kidney, which is subject to a toxic nephritis, often improves after the removal of the tuberculous side. Eight cases where casts and albumin were present before the operation, all except one remained well afterwards, and there was complete clearing of the urine. The presence of simple pyelitis in the second kidney is no contraindication to nephrectomy, as we have demonstrated in several cases. After removing the tuberculous kidney the infection can be cleaned on the opposite side.

The X-ray.—In a perfect X-ray plate, showing the kidney outline, which can always be secured by care in the preparation of the patient and the photographing, the outlines and increased size of the kidney can be shown. Frequently, too, in these tuberculous kidneys shadows due to spots of calcification may be seen. Areas of caseation sometimes show.

Lichtenberg and Dietlen (*Mitt. a. d. Grenz. d. Med. u. Chir.*, 1911, xxiii, 739) have recently reported the skiagraphic findings in eleven cases of tuberculosis of the kidney studied by injecting collargol solution. The destruction of the papillæ and the irregular and ragged extensions into the kidney of the pelvic cavity they consider characteristic.

The use of collargol will demonstrate any cortical abscesses communicating with the pelvis and neatly outline dilatations of the ureter; it will also, if strictures are present, show their location. We have noted in tuberculosis that not much is added to the understanding of the case by the collargol pictures. It is, in our opinion, especially bad practice to inject both kidneys with collargol, as

it undoubtedly lowers the resistance of the organs and would tend to spread a beginning tuberculosis in a kidney which could not be removed, as is the case in bilateral involvement. Iodid of silver, two per cent., gives good results.

PROGNOSIS.

An essentially chronic disease, lasting for years, tuberculosis of the kidney in the majority of cases involves the bladder also, in its course, and, in fifty per cent., the second kidney. Efforts to estimate the actual duration of disease are difficult; Senator considers five years the time; Albarran, on the other hand, has given three. We personally would give at least five, but it is extremely difficult to say just what its duration will be in the individual case, for there are very great variations. Two years from the onset of symptoms there will usually be tuberculosis in the bladder, but certain cases will not show this. In one of our patients, Miss A. E., age 42, there had been symptoms for thirteen years, and the kidney removed showed cavities at both poles, with a healthy middle portion and no vesical involvement. On the other hand, in certain cases, the entire kidney was destroyed when the symptoms had been present for only a year. What determines the destructive power of the bacillus? It must be the individual resistance of a patient. The presence of secondary infection is not in our experience so important as indicated by some authors. In one case, Miss J. T., there had been a definite tuberculous and colon bacillus infection for eight years, and yet examinations showed active tissue still present. On the contrary, in other cases, such as Mrs. C. J. D., age 62, there was only moderate involvement of the kidney, though the bladder was very extensively diseased. This patient had only been having symptoms for six months. While the disease is chronic, the patient may have little discomfort and apparently enjoy robust health before involvement of the bladder, provided the ureter is open. The situation is very different when there is a definite involvement of the bladder. Such patients suffer from frequent micturition accompanied by burning; they have also a great deal of pain, and are among the most wretched people imaginable. Men, however, suffer more than women, owing to the involvement of the prostate gland as well as the bladder.

Very valuable studies as to the duration of life with untreated tuberculosis of the kidney have been made by Rafin, Hottinger, Wildbolz, Ekehorn, and Blum.

A full review of this work is found in the excellent paper of Rafin (*Jour. d'urol.*, 1912, ii, 517), who finds that the average duration of life in the

patients who have died within ten years is four years and six months. No less than 16 per cent. of the patients who have survived five years die between the 5th and 10th years of the disease. About 2 per cent. survive ten years.

Rochet, quoted by Rafin, has noted some cases remarkable for their chronicity. Among seven cases of bilateral tuberculosis one lived for ten years. Many observers regard the prognosis, so far as duration of life is concerned, as much better in women than in men.

Spontaneous Healing.—What is the expectation of renal tuberculosis healing spontaneously or by medicinal treatment? We are all familiar with the healing of gland, bone, and lung tuberculosis under favorable conditions, but a study of our specimens does not disclose any definite healing process in kidney tuberculosis, as pointed out under Pathology. The only healing definitely known is where a kidney is entirely destroyed and its ureter occluded. Such cases, however, are rare, and there is always the possibility of a re-lighting of the infection. Albarran, examining one hundred and three specimens in the Necker Museum, found sixteen of complete ureteral closure. Le Fur (*Ann. d. mal. d. org. génito-urin.*, 1903, xxi, 1734) has reported four which remained well for seven, four, three, and two years after this nature healing. A large number of our patients had been treated medicinally before coming to us, and in some of the earlier cases the effects of fresh air, feeding, and other usual means to relieve pulmonary tuberculosis were faithfully tried. Miss C. C., age 25, is an example of this. The patient apparently had a large amount of secreting kidney tissue, as shown by catheterization of the ureter of the kidney involved. She was so situated that every form of nursing could be secured without taxing her resources, and she was treated for a year, but grew steadily worse, in spite of the fact that her general physique improved. In another case, Miss W. W., age 23, the same treatment was tried with the result that the bladder became involved in six months.

From what has been said about the excretion of tubercle bacilli in cases of pulmonary tuberculosis, it can be readily understood that the mere appearance of tubercle bacilli in the urine, without symptoms, pus, or blood, may occur without kidney involvement. Seven cases are reported by M. Pechère (*Bull. Soc. roy. d. s. méd. et nat. de Brux.*, 1905, lxiii, 40), in which a cure apparently followed medicinal treatment, but no careful urinary notes are on record regarding them. They probably belonged to the class named. Max Schüller (*Mitt. aus den Grenzgeb. d. Med. und Chir.*, 1906, xv, 208) gives a case of a man forty years old, with tuberculosis of the lungs, bladder, kidney, and testicles, who was treated for a year with guaiacol administered in doses of from twelve to twenty drops in water three times a day; thirteen years

afterward he was reported to be well. A somewhat similar case is reported in the *Württemberg Correspondenzblatt*, July 9, 1904, where tuberculin was given.

We have never personally observed—and this is the experience of practically all surgeons dealing extensively with tuberculosis of the kidney—any healing in tuberculosis of the kidney, with the exception of cases where the ureter is closed, nor does the study of the pathological specimens encourage such belief. It must be remembered, however, that the disease is sometimes very chronic, and that even with a single kidney, and that tuberculous, a patient can remain in an excellent state of health for a long time. It is interesting to see how a run-down patient with a pyonephrosis of one side and a tuberculous kidney on the other will pick up in general condition after removal of the pyonephrotic kidney. One such case is now under our observation where tubercle bacilli are occasionally present in the urine of one side, yet the patient seems to be in very good condition; the vast majority of cases of tuberculous kidney, however, mean infection of the bladder, a painful, serious disease, lasting several years and resulting in death.

Results of Medical Treatment.—The results of medical treatment stand in marked contrast to those of operative surgery. The medical procedures are those used for pulmonary tuberculosis, with which the profession is so familiar, and consist of feeding, fresh air, and the employment of therapeutic doses of tuberculin.

As already stated, we have had one case in which there is evidence of healed renal tuberculosis. Healing here is not definitely established, because it is conceivable that the reduced function present in the left kidney is due to some other cause than tuberculosis; it is, nevertheless, highly suggestive.

TREATMENT.

The only satisfactory treatment of renal tuberculosis is operative, and should be carried out just so soon as a positive and complete diagnosis is made. The operation *par excellence* is nephrectomy, though occasionally a preliminary nephrotomy should precede it. There is a limited and still experimental field for partial nephrectomy in certain cases. Compared to the medical and expectant treatment, surgery has nowhere gained a more striking victory than in the treatment of renal tuberculosis. The reasons for early operation are as convincing as those for operating at all, for patients treated while the disease is limited to one kidney, in our experience, almost invariably get well. The re-

sults with extensive involvement of the bladder are not so bright; for, while many cases are rescued, some are not bettered. The primary mortality is principally in this group. When speaking of early and late cases we do not mean in time of symptoms, but in measure of the extension of the process. After five years one case may be early, and in six months another may be late.

Historical Considerations.—In the early days of surgery for tuberculous kidneys, nephrotomy, which usually meant incision and drainage of a tuberculous pus kidney, was considered as a serious rival for nephrectomy. This was largely due to the incomplete methods available for diagnosis and to the inferior technique of nephrectomy. Vigneron (*Thèse de Paris*, 1892) found the primary mortality in 139 nephrectomies for tuberculosis of the kidney 38.4 per cent. On the other hand the primary mortality from nephrotomies was only 12.7 per cent. It soon became evident, however, that many of the nephrotomy cases died in the months immediately following operation, and that few permanent cures resulted. Pousson (*Centrbl. f. Chir.*, 1901, xxviii, 82) estimated that out of 63 nephrotomies, 39 died within a year. In Pousson's collection of 161 nephrectomies, the primary mortality was 11.6 per cent., and the commonest cause of death was uremia. With the development of modern operative and examination methods the death rate, both primary and secondary, in nephrectomy for tuberculosis of the kidney has steadily fallen. Legueu ("Traité chirurgical d'urologie"), in 680 cases from European surgeons, finds a primary mortality of about 7 per cent. In the case of Albarran—118 cases—the rate was less than 4 per cent. W. F. Braasch, reporting a series of 203 nephrectomies for tuberculosis from the Mayo Clinic at Rochester, Minn., records a primary death rate of only 2.9 per cent. Our own death rate (mostly Kelly's operations) has been 4 per cent. in 100 cases.

Although the primary death rate has been small, there are very few statistical records in regard to the ultimate outcome. This depends so much upon the character of the case and the complication in other organs that statistics are rather dubious.

Braasch could only obtain reports from 70 per cent. of his cases which had been operated on more than a year previously, and of this number no less than 18 per cent. were dead. In our own series the secondary death rate in a period of over a year, and running back to cases operated on nearly twenty years ago, has been 10.9 per cent. We have kept records of all. Krönlein (*Folia Urologica*, 1908, iii, 245) followed 71 cases from 1890 to 1908; of these 71, 18 died; 14 in the first year and 4 others in from four to six years after operation. Albarran, who followed 39 cases, found that 5 died from the infection within 3 years after the operation, the other 34 apparently remained well. Our own

rate of cure has been 81.9 per cent., the death rate 18.1 per cent., and we would repeat that where the disease is limited to the kidney the primary and secondary death rate is almost *nil*.

On the other hand, taking cases with advanced vesical tuberculosis as well as tuberculosis elsewhere in the body, the death rate, both primary and secondary, will be much greater. In this class nephrectomy is but the beginning of treatment. It must be followed by treatments of the bladder and perhaps operations upon it, extending over a period of several years. This will be treated under Tuberculosis of the Bladder.

The presence of tuberculosis in other parts of the body is not a contra-indication to nephrectomy. We find the association between tuberculosis of the kidney and tuberculosis of the genital organs in woman is almost as common as in man, and patients with active pulmonary tuberculosis, but with the most aggravated symptoms from the kidney, are often benefited by nephrectomy.

So far as our own cases are concerned the relative results in the different groups have been as follows:

First, in 30 per cent. the tuberculosis was clinically limited to the kidneys. There have been no primary or secondary deaths.

Second, in 56½ per cent. there was extensive involvement of the bladder as well as of the kidney. The primary death rate has been 11.5 per cent. Within one year after operation the death rate in this group has been 26 per cent.; the percentage of absolute cures about 60 per cent.

Third, 8 per cent. had pulmonary tuberculosis in addition to the renal. The total death rate, primary and secondary, has been 20 per cent., and 80 per cent. are apparently cured.

Fourth, 8 per cent. have been associated with tuberculosis of the tubes and ovaries. In this group there has been no primary death from operation, but 20 per cent. secondary deaths. In these cases the affected genital organs were removed as well as the kidneys.

Causes of Death After Nephrectomy for Tuberculosis.—O. G. Ramsay (*Ann. Surg.*, 1900, xxxii, 461) has collected the causes of death in 37 cases occurring after 191 nephrectomies. Fourteen were due to disease of the opposite kidney and in only three of these was the cause an active tuberculosis. Among other causes were collapse, peritonitis, septicemia, hemorrhage, exhaustion, necrosis of the bowel, etc. An unusual case is that of Jenckel (*Dtsche. Ztschr. f. Chir.*, 1905, lxxviii, 593) where, after a nephrectomy, the patient died on the fifth day with complete anuria. The autopsy showed a perfectly normal-appearing kidney.

Braasch states that the cases ending fatally in his series showed at autopsy general miliary tuberculosis, and we ourselves had one such case. Deaths from tuberculous meningitis are also on record, but the large majority of primary deaths are due to insufficiency of the kidney left *in situ*.

Technique of Nephrectomy.—The lumbar or extraperitoneal method is applicable to, and should be employed in, all cases. The posture of patient is, as shown in Figure 173, upon an Edebohls air bag, so that the space between the lowest rib and the crest of the ilium is extended to its maximum. Make the incision (Fig. 183) from four to five centimeters in front of Petit's triangle, and extend it from the angle of the twelfth rib above, well around to the crest of the ilium below. It is better always to cut the muscles and not to attempt muscle separation, as done in cases of movable kidney. Specially take care to avoid injury of the first lumbar and the last dorsal nerves. If the perirenal fat is not involved, an incision of this kind will suffice to get the kidney out, but if the kidney is very large and very adherent, a lateral extension can be made across the abdominal muscle beginning about its middle (Fig. 190), which gives the so-called frying-pan incision. This affords a wide exposure, and makes possible an easy dissection of the kidney from its surroundings. It is rarely necessary to break or to excise the twelfth rib, though it may have to be done occasionally, when the upper pole of the kidney is densely adherent. It should be avoided whenever possible, as infection of the rib with a tuberculous process may result. Note well, in selecting the place of incision, that the larger the mass the farther anterior should the incision be made. In very large kidneys (Operations on Tumors of Kidney) an actual anterior incision is best, but, whichever is made, take every care to avoid injuring the peritoneum. Equally important is it, in removing tuberculous kidneys, to keep in mind that thorough mobilization should be secured before attempting to tie off the pedicle, otherwise serious accidents may result. After making the incision down to Gerota's capsule, perforate this and so expose the perirenal fat. When this is evidently not involved, the kidney can be partly pulled down by means of it, a number of clamps being applied in the method which we have described under suspension of the kidney.

Going through the perirenal fat, free the kidney everywhere gradually by working the hand through the adhesions. When entirely free, the kidney is delivered.

The next step is the tying off of the vascular pedicle. This can generally be attacked in one of two ways, the choice to be determined by the operator while he is working. Sometimes it is more convenient to begin tying off above (Figs. 293 and 294), going through the pedicle step by step. One strong cat-

gut ligature is applied and tied; that part of the pedicle is cut through; the next ligature is applied underneath that, and so on until all blood-vessels are

FIG. 293.—NEPHRECTOMY FROM ABOVE DOWNWARD FOR TUBERCULOSIS OF THE KIDNEY.
Note vascular pedicle, and position of first ligature. The arrows 1, 2 and 3 show the plane in which pedicle is cut across. The ligature is tied, then the pedicle is cut through for a little distance, then the next ligature is tied, etc. The line of severance should be as close to the kidney as possible, so as to afford a good stump. This procedure is adapted to those cases where the disease is at the lower pole and where the upper pole can be readily freed and delivered through the incision.

ligated. An aneurysm needle is a suitable instrument with which to pass the sutures in tying off the pedicle, as it obviates any risk of tearing or cutting the veins. Leave as much room as possible beyond the ligature, and to ensure this, cut the pedicle as near the kidney hilum as possible. We have found it very convenient, after tying, to apply several clamps outside of the one holding the pedicle, thus insuring against retraction after cutting.

FIG. 294.—SECOND STEP IN NEPHRECTOMY FROM ABOVE DOWNWARD FOR TUBERCULOSIS OF THE KIDNEY. The uppermost vessel has been doubly tied and cut between, as shown. The next ligature is being set with aneurysm needle. Instead of ligation on the renal side, it is frequently more convenient to employ clamps.

FIG. 295.—NEPHRECTOMY FROM BELOW UPWARD FOR TUBERCULOSIS OF THE KIDNEY.

The first step is, as shown by arrow 1, the severance of the ureter near its pelvic junction and the sterilization of the cut ends. The stripping up of the ureter makes accessible the vascular renal pedicle, which is tied off in progressive steps, from below up. This is the reverse of the method from above downward, and the same precautions should be observed. This procedure is adapted to those cases where the lower pole is more readily delivered than the upper pole. The operator will often have to decide after trying as to which method is to be preferred.

After getting all the way through the pedicle the ureter may be ligated and cut through with a cautery knife and the kidney removed.

But note that just the reverse procedure may be the most applicable. The ureter is cut through first, the lower pole turned up (Fig. 295), and the pedicle ligated from below upward with catgut. It is highly important in going through the pedicle to ligate the vessels separately, and this can be greatly

facilitated by dissecting off the fat. A convenient method of doing this is by means of a small, flat, crenated dissector. Special care should be taken in reference to the right renal vein, adhesions to the liver must be dealt with most carefully, and, if at any point in the operation bleeding is profuse, do not clamp hastily, but stop the bleeding by pressure, and then carefully clamp. Occasionally it is impossible to apply ligatures to the pedicle. Under such conditions one can apply clamps and leave them on for several days (Fig. 296), but this is a risky procedure.

FIG. 296. — RAPID REMOVAL OF KIDNEY, CLAMP METHOD. To be used when great haste is necessary, especially when one of the renal veins has been torn.

Exceeding care is necessary in removing the peritoneum from the anterior

surface of the kidney. Not infrequently there are dense adhesions in this direction, and the intestine may be injured, especially on the right side, while a duodenal fistula is not an easy complication to face. Removal of the perirenal fat is best done after the removal of the kidney, and even if this is not done, the case will do very well. Lymphatic glands manifestly enlarged at the pelvis certainly call for excision.

What to do with the ureter after removal of the kidney is a problem which will confront every surgeon. Our first complete ureterectomy was in 1896, since when we have done it in many cases. When to perform it must be decided by the operator. Our own views we will take up a little later; just now we

will consider the method of removal. In the earlier cases we extended the incision made to remove the kidney around the abdomen, after the manner employed by Israel, almost cutting the patient in half. Later, after freeing the kidney from its pedicle and all its attachments except the ureter, we made a second incision, about four inches long, parallel to Poupart's ligament (Figs. 192 and 193), and pushed the kidney down to this underneath the peritoneum, thus removing it and the ureter in a single piece; now we cut the ureter in two near its junction with the pelvis of the kidney and sterilize it by means of a cautery.

The ureter may be thus isolated, drawn under the bridge of the abdominal wall, and freed down to the bladder a simple procedure in the male, but complicated in the female by the passage of the ureter through the broad ligament. At first we regularly cut the uterine artery in order to get to the ureter, but later found this not necessary, for the artery could be lifted up, the ureter freed, and a cone of bladder pulled back underneath the artery (Fig. 196). It is possible to excise that

FIG. 297.—KIDNEY, URETER AND PART OF THE BLADDER INCLUDING URETERAL ORIFICE REMOVED IN ONE PIECE FOR TUBERCULOSIS OF PARTS CONCERNED. The tubercular process is shown on the surface of the lower pole of the kidney, and throughout the ureter, especially its vesical end, by great thickness, and in the interior of the bladder by golf-hole ureteral orifice and tubercular patches. (Mrs. M.)

part of the bladder immediately around the ureteral orifice in the bladder, and to turn in the bladder with catgut sutures (Figs. 297 and 298). In some cases where the lower end of the ureter is manifestly healthy this is not necessary,

FIG. 298.—VIEW OF THE ABDOMEN SHOWING POSITION AND EXTENT OF INCISIONS NECESSARY FOR REMOVAL OF SPECIMEN SHOWN IN PRECEDING FIGURE. There were two incisions through the abdominal wall, one the usual lumbar incision through which the kidney was severed from its vascular pedicle, being then pushed down and brought into the peritoneal cavity, through the incision shown in pelvic brim. The ovarian vessels left intact. Ureter and bladder exposed by incision shown anterior to tube. The uterine artery was sacrificed on this side. (Mrs. McH.)

but the ureter is tied off with catgut and simply buried after cauterization of its end. When the entire ureter is left in, we prefer, as a rule, to bury it, rather than sew it into the incision.

Intracapsular Nephrectomy.—Intracapsular nephrectomy is of great value

in the large pyonephrotic tuberculous kidneys, and is usually secondary to a nephrotomy, its results, in our experience, being remarkably satisfactory. The sinus in the back persists longer than after an ordinary nephrectomy, but that will heal up. Out of eight such cases one closed in six months, one in a year, one in two years, one in three years, one in thirty months, and three are still open.

As to operation, it is done after the following manner: Incision is made through the capsule; the hand is worked around between the capsule and the kidney, which is rapidly delivered, in some cases being taken out in pieces. As it is pulled up, the forceps are applied to the pedicle, which comes nicely into view. Very little hemorrhage follows, as this method is usually employed in those cases where there has been most extensive kidney destruction, and consequent interference with the blood supply (Figs. 401, 402, and 403). As the kidney is removed in pieces, and the clamps applied, we have at the conclusion the condition shown in Figure 404. The clamps are then carefully replaced from above downward, by catgut sutures, thus thoroughly controlling hemorrhage. The whole operation need take but a few minutes and can well be done under gas anesthesia. The incision is drained with iodoform gauze, and we find it extremely valuable to inject an oil mixture of iodoform emulsion.

Before taking up the results of nephrectomy and the post-operative complications, let us consider nephrotomy.

Nephrotomy and Resection of Kidney.—Nephrotomy is now limited to the opening of large abscesses and employed merely as a palliative measure, or preparatory to a later nephrectomy; it is in no way to be considered a substitute for it. The old method of opening tuberculous kidneys, with an idea of healing, similar to the mere opening of tuberculous foci anywhere else in the body, has proved inefficient.

Nephrotomy, being limited to abscess cases, is very simply done. An incision is made over the most prominent part of the mass down to the kidney; this is reached by means of a blunt clamp, the kidney is opened freely, and the pus evacuated. After emptying, it is best to put in a large gauze drain. It is truly remarkable how rapidly patients who have even reached a stage of extreme exhaustion recover after this operation. Patients who seem to be inevitably subjects for death are frequently saved in a manner almost startling. Nephrotomy is occasionally the only operation possible, that is, when there is only one kidney, or occasionally when both kidneys are involved and one is pyonephrotic. Our own experience with nephrotomy where both kidneys are involved is not very satisfactory, for in four cases where we employed it, all died within two months after operation; all were distressed with fistula in the

side, and all received no benefit whatever. However, cases are recorded in the literature where benefit apparently followed. Pousson quotes a most interesting one, with normal urine, where the tuberculosis, of the caseo-cavernous type, was located entirely in the kidney cortex. He did a nephrotomy with extensive removal of the diseased parts, and, although the urine continued normal from that kidney, the fistula persisted in the side, and sixteen months later he found a nephrectomy necessary, which disclosed an active tuberculosis of the organ.

Conservative Operations on Kidney.—When one kidney is perfectly sound conservative operation upon the other is not indicated; a nephrectomy is better. On the other hand, in cases where both kidneys are involved, it is justifiable, in the present state of our knowledge, to attempt conservative operation to cure the one, for, if it can be so cured, then the other may be likewise treated or actually removed. Our personal experience with this method of operating is not very encouraging. In one case, although the urinary examination showed tuberculosis to be definitely present, it was quite difficult to find it on exposing the kidney, and required considerable manipulation of the organ; finally a small focus the size of a hazel-nut was removed from the upper pole. This was in reality the better kidney, although the other was actively secreting. The patient recovered, but continued to have marked tuberculous symptoms, and died six months later of complete anuria, having suffered with a remarkable form of hematuria from the kidney, in which she passed entire casts of the ureter. Autopsy showed the kidney operated upon to be almost destroyed by tuberculosis.

Another of my own cases illustrates the deleterious influence of manipulation upon a tuberculous kidney:

Miss B. D., admitted to the Johns Hopkins Hospital Sept. 5, 1905, with tubercle bacilli and pus coming from right kidney. The resident explored the kidney, but found a normal looking organ, and even after doing a nephrotomy he could see no evidence of tuberculosis. The kidney was therefore sewed up. Six months later, on April 2, 1906, the symptoms having increased, this patient returned, and we removed the kidney, which was found to be entirely destroyed by tuberculosis.

Seven such cases are reported by Morris in his "Diseases of the Kidney and Ureter," and three had to undergo a subsequent nephrectomy. One was well four, another three, years after operation. To quote again: Morris removed the upper third of a solitary tuberculous kidney, and four years after this operation the patient was in apparently perfectly good health. Israel, in 1896, did a partial nephrectomy upon a patient who enjoyed seemingly good health for four years afterwards. The symptoms returned following a pregnancy, and it was necessary to do a nephrectomy. Kramer reports several successful cases

operated upon by Bardenheuer, while Dr. Christian Fenger, a pioneer in this field, attempted several cases, but by private communication some time before his death told me that all of them had relapsed. Dr. Francis Watson, of Boston, also tells us of a similar experience. Dr. Henry T. Williams, of Rochester, N. Y., had a male case where the man was apparently well four or five years after operation, and the late Professor Lennander, of Upsala, reported the successful removal of a double kidney.

To illustrate the possibilities of this form of surgery I quote the case of Mrs. S. (Fig. 281): The patient had a double blood supply and a double pelvis to the tuberculous kidney, the two kidneys being thus anatomically disassociated. The tuberculosis, as shown, was so limited that the upper pole was entirely destroyed by the tuberculous process, whereas the lower one was normal. The upper kidney was not secreting at all, and the lower one excreted normal urine. In such a case it would have been very simple to have cut directly across and resected the kidney, an operation occasionally possible, as shown by what we have found in our studies of specimens with regard to locating the disease (see Pathology). It is always a temptation, where there is bilateral renal tuberculosis, to attempt some such operation when the almost certain progress of the disease when left alone is considered, but we think that it is best to limit the operation to this group of cases, owing to the excellent results obtained by nephrectomy.

Complications of Operation.—Most patients do well after operation, and our four primary deaths were due in two cases to anuria, in one to peritonitis, and in one to general infection. The commonest complication is a persistent sinus in the side. This occurs most commonly when there is perirenal infection, and may persist for years, though in most cases it finally closes. In many of the patients there may be vesical distress, either with or without tuberculosis of the bladder, for long periods of time.

TUBERCULOSIS OF THE URETERS.

The pathology and occurrence of ureteral tuberculosis have already been described. In most cases the treatment is removal of the kidney above. It is rarely necessary to perform the operation shown in Figures 194-196. In some cases, however, there is no relief of vesical symptoms until the ureter is removed, and in not a few there may be attacks of colic in the affected organ even when the kidney is gone. If, after a prolonged period of waiting, these symptoms persist, the proper treatment is to remove the ureter, as shown in Figures 194-196.

TUBERCULOSIS OF THE BLADDER.

Tuberculosis of the bladder is said to occur as a primary disease in a small percentage of cases of urinary tuberculosis. In two patients we have observed bladder tuberculosis without any evidence of renal trouble. Both of them were women, and both were relieved, after extensive local treatments, by removal of the affected parts of the bladder through suprapubic openings. Casper (*Dtsche. med. Wchnschr.*, 1900, xxvi, 661; 673) describes three cases of apparently primary bladder tuberculosis. It is said to be commoner in males than in females.

As a rule, and, indeed, almost without exception, tuberculosis of the bladder in a woman means tuberculosis of the kidneys. In the male, on the other hand, there is frequently a bladder tuberculosis which is secondary to tuberculosis of the genital organs, particularly of the prostate gland and of the seminal vesicles. We have never observed a bladder tuberculosis following tuberculosis of the tubes in a woman.

Pathology.—The most thorough and comprehensive report in existence in regard to tuberculosis of the bladder is that of Hallé and Motz (*Ann. d. mal. d. org. génito-urin.*, 1904, xxii, 161). They divide the stages into several

steps: in the first there is simple disseminated tubercle formation with occasional superficial ulceration and the disease is limited to the mucosa. In the second stage the ulcerations are deep and there are frequent extensions into the muscle layers. In the third the entire bladder wall may be destroyed, and in the fourth extensive involvement occurs in the perivesical tissues. While

FIG. 299.—CYSTOSCOPIC VIEW OF RIGHT AND LEFT URETERAL ORIFICES; TUBERCULOSIS OF LEFT KIDNEY. Note corona of tubercles, around left orifice, and normal right orifice. (Miss M. D., March 16, 1908.)

these extensive processes are met with in autopsy specimens they are rarely seen in life. In most of our patients the disease has been limited to certain parts of the bladder. This is often around the orifice (Fig. 299) of the affected ureter, but it may be anywhere (Fig. 300). In addition to tubercle formations

there is often a marked inflammatory reaction, due perhaps to toxins, and described under Tuberculosis of the Ureter. In the prolonged and advanced cases there is usually marked contraction of the bladder. This is due in part to the tuberculous process, but also to the almost continuous spasm of the organ due to irritation. The cystoscopic appearances as well as the symptoms occasioned by tuberculosis of the bladder have already been described.

Prognosis.—A few years ago tuberculosis of the bladder was regarded as an incurable disease. Its mere presence was enough to contraindicate operation. It is perfectly certain now that, provided the primary cause is removed, many patients suffering with bladder tuberculosis can be cured. The lighter the condition and the less extensive the process the surer this result. Our experience in this connection has been confined almost entirely to women. Provided, however, there is no associated genital tuberculosis we believe that the course of the disease in the two sexes is identical. In cases where the affected kidney becomes shut off by occlusion of its ureter, there might be spontaneous healing, but such a result must be extremely rare. In our opinion, without the removal of the primary cause, such patients inevitably go from bad to worse.

Treatment.—The first step in treatment is the removal of the primary cause, and in the female this is the kidney. In the milder cases removal of the kidney alone often suffices to cause a cure. If, after removal of the kidney, the general and local measures to be described fail, the next step to take is to form a vesico-vaginal fistula. The technique of this operation is shown in Figures 557 and 558. It is carried out by introducing a sound into the bladder, pressing down the trigonum between the urethral orifices, and incising from the vagina into the bladder. The opening should be wide, and, to prevent spontaneous closing, it is most important to bring the vesical mucous membrane to the vaginal by suturing. Having formed such a fistula it should be left open for six months or longer. From time to time cystoscopic examinations will show progress. When the healing is complete the fistula can be closed and, by gradual dilatations, the capacity of the contracted bladder restored. After such treatment, in many of these cases, the disease is found to be limited to a single spot in the bladder; indeed, the tuberculous process may have disappeared and nothing remain except a reddened inflamed area which, however, keeps up the irritation to such an extent that the patient feels no relief. We have frequently had bladders which could be

FIG. 300.—CYSTOSCOPIC VIEW OF PATCH OF DISCRETE TUBERCLES ON MUCOUS MEMBRANE OF BLADDER. (Norinski, Nov. 12, 1906. Cystoscopic Clinic.)

dilated to 300 c.c., and yet the patients were voiding every hour or so, night and day.

In such cases there is rarely any relief from local applications through the urethra, and the best results have been obtained by following a plan devised by one of us (Kelly), which has proved successful in a number of cases. This is to open the bladder by the suprapubic route and make a transverse incision through skin, fat, and fascia parallel to the pubes. The muscles are opened in the middle line. A catheter introduced into the bladder through the urethra affords a means of distending it with air. The peritoneal reflexion is pushed down and the bladder widely opened in a transverse direction. With the patient in a high Trendelenburg posture there is perfect exposure of the interior of the bladder. The spot is excised and the defect in the bladder wall closed with a triple *o* chromic catgut suture threaded on a fine staphylorrhaphy needle. No suture appears in the bladder, which is then closed with the same suture material. The best stitch is a continuous one, and care should be taken that the suture does not present in the bladder and that the fascia covering the bladder is brought together. The incision may then be closed in any desired way, and it is well to put a small drain down to the prevesical space. The steps of this procedure are shown in Figures 598-602. The results have been most satisfactory.

Excision of the Bladder for Incurable Tuberculosis.—There are occasional cases, particularly in the male, where, in spite of removal of the diseased kidney and drainage of the bladder, the vesical tuberculosis persists and gives rise to unbearable suffering. There are four or five reports in the literature where the entire bladder has been removed for this condition and the ureter implanted into the bowel. The death rate in these cases has been about 50 per cent.

A much simpler procedure is the cutting off of the ureter from the bladder and its implantation into the skin or into the bowel. The second procedure is inferior to the former owing to the rather high death rate from ascending renal infection.

André Boeckl (*Jour. d'urol.*, 1912, i, 345) has reported the literature of this subject. The patients may be given a number of years of comparative comfort by means of this procedure. In the cases where the implantation has been on the skin convenient apparatus may be employed to collect the urine. The treatment, however, is only palliative, as most of these patients die of their disease within a few years. Where there is a pyonephrosis of the remaining kidney it is better to do a nephrotomy than ureterotomy.

Medical Treatment of Bladder Tuberculosis.—It must be emphasized that treatment will be of little avail until the source of the disease, the infected

kidney, is removed. Other things being equal, there can be no question of the value of fresh air and nourishing food.

J. G. Pardoe (*Lancet*, 1905, ii, 1766) has reported extremely valuable results from the therapeutic use of tuberculin. An interesting report along this line has also been made by Dr. J. Pedersen (*New York Med. J.*, 1911, xciii, 371). In two cases he saw complete clearing up of the urine, of both tubercle bacilli and pus. We have been observing a number of cases of tuberculin treatment, but have not been convinced of its value. However, it certainly does no harm.

The best topical application is carbolic acid, which was first advocated by Professor Rovsing of Copenhagen. Our experiences with the 5 per cent. solution advocated by Rovsing have not been entirely favorable. On the other hand, with $\frac{1}{2}$ and 1 per cent. solutions there have been apparently marked improvements in many patients. Carbolic acid of this strength has a marked anesthetic action, and is one of the best fluids for dilating a contracted bladder. After a nephrectomy all of these measures should be put to trial before resorting to any of the operative procedures advocated.

CHAPTER XX.

RENAL AND URETERAL STONES.

Nephrolithiasis is the term employed to designate the condition of stones in the kidney. Not only the kidney, but every part of the urinary tract may be the initial location of stone formation. The migration of stones from the upper part of the tract to the lower segments is a common occurrence. A stone originating in one of the kidney calices may remain there, or it may pass to the renal pelvis to develop further, or, passing onward, enter and lodge in the ureter, from which it may escape, to form the nucleus of a bladder stone. The injuries which a kidney may suffer from the presence of stone in it are manifold: obstruction leads to hydronephrosis, infection to pyonephrosis, and the mere presence of the stone, through mechanical irritation, to various degenerative changes.

HISTORY.

Stone kidney is one of the oldest diseases known to medicine. Hippocrates not only records the condition with accuracy and in detail but describes surgical procedures for the removal of stones from pyonephrotic kidneys.

Serapion, a Damascus physician of the ninth or tenth century, makes mention of operations for stones in the kidney. Avicenna, in the eleventh century, also speaks of operations through the back and loin, but expresses the belief that they are unjustifiable. Subsequent to Avicenna, who not only describes the operation but also speaks of perirenal abscesses and the difficulty of healing them, a number of centuries elapsed before any new mention was made of the subject. Guy de Chauliac holds that the stones are formed in the kidney from kidney sand, and offers a number of medicinal methods of dissolving the stones, saying that, if these are unsatisfactory, the stones may be removed from the bladder by operation. From the fifteenth century on can be found numerous accounts of successful stone removals, in French, German, and English literature. Rayer quotes "*Les chroniques de Jean de Troyes*," in which is given an account of the death of Louis XI. This account, however, is

more or less apocryphal, and it is difficult to determine whether the stone was really removed from the kidney or from the bladder, and whether it was in the time of Louis XI or Charles VII. Riolan, in his work on anatomy, describes cases in which stones are present in the pelvis of the kidney and in the ureter. He gives an excellent description of the ordinary coral stone and goes so far as to advise operation to remove these stones. His publication was in 1649. In 1670, in an endeavor to throw some light on this subject, the Italian Zambecari wrote to Fradi in the "*Nova Acta Eruditorum*," describing some experiments on animals, among others nephrotomies on dogs. Blankaart, in 1690, suggests the removal by nephrectomy of the stone kidney, although he does not say that he ever did it. Peter von Forrest, in the seventeenth century, advises against opening kidney abscesses, citing two cases that died within a short time after operation; also another case in which there was present a renal sinus. The famous Nicholas Tulp, whom Rembrandt immortalized, gives excellent pathological descriptions of stone kidneys. He opposes the attempt to remove stones from the kidney, because it would cause such a tearing of the kidney to get them out. One of the most remarkable descriptions of a nephrotomy for stone in the old literature comes to us from Charles Bernard, and concerns a certain Hobson who was the English Consul at Venice. He went to the famous Italian physician, Dominico de Marchetti, and demanded an operation upon his kidney. The physician advised against operation, but the obstinate insistence of the Englishman ultimately overruled his objections and he operated. With a knife he cut through the various layers of the abdominal wall to the kidney. On account of the extreme bleeding, however, he packed the wound after reaching the kidney, and at a second operation opened the kidney and removed several stones. This patient had a fistula in the side for some time, but this finally closed, and a number of years later Dr. Downs, who saw him in England, as did also Tyson and Bernard, found that he was in splendid condition in every way. This case is the first absolutely authentic nephrotomy that we know of in literature. Schurig was the first to give the name of nephrolithotomy to the operation; the older operators called it simply nephrotomy.

During the entire eighteenth century there was great discussion whether to open a kidney abscess with a knife, with cauter, or to let it alone. Passing rapidly over the work of the early eighteenth century, we come to the great father of kidney pathology, Rayer, whose work dates from 1841. He noted that the kidney stones were practically always in the pelvis of the kidney. He says that, if there is no swelling in the side, and if the strength of the patient is uninfluenced, no operation should be thought of. He speaks of the

folly of doing a nephrectomy in such cases, although granting, as he himself has proven, that it can be done on animals, without bad results. Comhaire, in 1803, had also operated on dogs, and showed beyond any question that a kidney could be removed without impairing the urine-secreting function. At the end of the sixth decade of the last century Thomas Smith recommended the freeing and delivering of the kidney, when there was no abscess present, and the palpation showed stones. Reidner and Maunder performed such procedures on the cadaver with success.

Unfortunately for those who followed Smith's advice, among whom were Durham, Gunn, Barber, and others, the then existing methods of diagnosis were so incomplete that kidneys removed for calculus, in spite of a normal appearance, proved to contain no stones. The first nephrotomy carried out on an apparently normal kidney was that of Morris, 1880. During the next year Czerny removed a stone from the pelvis of the kidney by pyelotomy. For some years pyelotomy was the operation of preference. It yielded place to nephrotomy for a great number of years, but is now once more coming to the front as the operation of choice.

ETIOLOGY.

The essential conditions which lead to stone formation in the kidneys are imperfectly understood. Race, age, sex, habits, diet, none of them seem to play a great part. The stones which are found in the kidney are composed of substances normally present in the urine. The problem to determine is, why these salts are precipitated into stones in some cases and not in others. Before passing to this point, however, we will note the character of stones which form in this region.

Character of Kidney Stones.—A few stones are composed of one salt; most are made up of a great mixture of salts. They vary immensely in size, shape, and number. The frontispiece shows thirty kidneys and bladder stones from our collection and that of Dr. Hugh H. Young, which have been chemically investigated by Dr. G. L. Gordon, of Vancouver, B. C. His notes as to the chemical composition and the physical structure are as follows:

1. A urate stone of the sedentary period of life, the outer layers of which are infiltrated with triple phosphates from infection.
2. A urate concrement the matrix of which has not been invaded, although the entire surface is coated with triple phosphates.
3. An oxalate center surrounded by a urate layer, which, on the periphery,

has become infected so as to admit of infiltration with triple phosphates and oxalates.

4. A urate, the outer layer of which has become infected and infiltrated with triple phosphates.

5. The urate of infarct origin. The outer part of this has been infiltrated with triple phosphates and oxalates and the whole periphery coated with these salts.

6. A pure urate stone under the surfaces; a lamina was added while methylene blue was in the urine.

7. The center of urate, the next layer urate, oxalates, and bone earth. The next layer urates only. The outermost layer is urate infiltrated with triple phosphates.

8. Twin agglutinated urate centers of infarct origin, the outer layers are infiltrated with triple phosphates.

9. Amorphous phosphates in nucleus. These are surrounded by oxalates adulterated with bone earth. The whole is then covered with triple phosphates.

10. Pure urate.

11. Urate oxalate coated with triple phosphate.

12. A jack stone with oxalate center, over which are applied alternating layers of urates and oxalates.

13. Urate, oxalate, and triple phosphate throughout.

14. Urate nucleus with triple phosphate covering.

15. Oxalate surrounded by triple phosphates.

16. Urate of infarct origin, which has been covered with blood clot, and the blood clot infiltrated with calcium oxalate.

17. Shows a broken catheter end surrounded by triple phosphates.

18. Equally composed of uric urates and oxalates.

19. Triple phosphates pure.

20. Pure cystin. Note the character of the striation, which is radial rather than concentric. This is characteristic of this type of stone.

21. The nucleus is composed of a bit of tissue, containing diplococci and a few bacilli. This nucleus is covered with a layer of triple phosphate.

22. Shows a pin-headed urate center surrounded by laminæ of oxalates contaminated with bone earth.

23. Amorphous phosphates in powder form covered with a thick layer of triple phosphates.

24. Pure oxalate jackstone. This stone may take its origin from the elongation of the protuberances of the mulberry-shaped stone. It is possible that the growth of the protuberances is due to blood, occasioned

by trauma of the bladder and collected upon them, in which oxalates are deposited.

25. An absorbent cotton nucleus with triple phosphate coat.
26. A hair nucleus, triple phosphate coat.
27. A pure bone earth calculus.
28. Shows a center of fiber surrounded by a shell of oxalates.
29. A pure oxalate from the ureter.
30. An oxalate hemp-seed center with flakes of triple phosphate.

When the nuclei of the stones are studied it is evident that uric acid and urate stones are the most frequent. This conforms with the view of Ebstein, and is certainly true so far as the structure of stones, which are spontaneously passed, is concerned. It is equally apparent that in mixed stones the phosphates ultimately predominate. In Dr. Gordon's series (frontispiece) the nucleus of the stone was eleven times uric acid and urates, eight times phosphates, seven times oxalates, and four times mixed. Israel found phosphates in 42.8 per cent., oxalates in 32.6 per cent., urates and uric acid in 20.4 per cent., and sulphur and xanthin in 2 per cent. of his cases.

The great variation in size, shape, and appearance of kidney stones is to be expected when one considers the variety of constitution.

FIG. 301.—CORAL CALCULI CHOKING PELVIS AND CALICES OF KIDNEY. Note fracture at junction of upper major calyx and pelvis. Some parenchyma still remains; catheterization of the kidney had shown, however, that it was dead. The right kidney showed compensatory hypertrophy, and chains of calcareous deposits in the parenchyma. Specimen obtained at autopsy. $\frac{1}{2}$ natural size. (Miss A. C. T., Gyn. No. 7648, Autopsy No. 4520. See Fig. 339.)

The uric acid and urate stones, if pure, rarely grow larger than a cherry stone, are of a dull grayish color, sometimes reddish, have a smooth surface,

and are quite hard. This is a stone peculiarly adapted to passing through the ureter during attacks of kidney colic.

The oxalate stones are hard, showing a crystalline, rough surface, which gives them the appearance of a mulberry. It is this type of stone which develops into the occasional and interesting jackstone. The phosphate stones may be composed of either calcium phosphate, or the tripl phosphates of ammonium

FIG. 302.—LARGE CORAL STONE IN PELVIS OF KIDNEY, EXTENDING INTO CALICES. Associated with a dilated pelvis containing 50 c. c. of fluid in addition to the stones. The parenchyma was entirely destroyed and the kidney functionless. The only symptom was a slight aching in the affected side which had been present but six months. This specimen was obtained by operation. The opposite kidney was normal and the patient has remained well since operation. (Mrs. E. H., Gyn. No. 7206, Sept. 18, 1899.)

FIG. 303.—IMMENSE STONES FILLING LOWER HALF OF KIDNEY, WITH NORMAL UPPER HALF. Note nephrotomy scar from previous operation, also large polished facets between the two larger stones, due to the fixation of the lower pole while the upper moved in respiration. The nephrotomy scar noted was made July 15, 1898, by J. Bloodgood, who found 200 c.c. of purulent fluid, but no stones in lower pole of kidney. In August, 1898, the patient passed three calculi spontaneously. In March, 1896, the X-ray showed no stones. (Mr. G. K., Ch. H. and Inf., Nov. 23, 1910. From Thos. S. Cullen.)

and magnesium. Pure calcium phosphate stones are rather rare. Phosphate stones are frequently faceted, and are often multiple. The huge coral stones are for the most part made up of phosphates. The unusual cystin stone, one of which is shown in the frontispiece, is of a dirty yellowish color, and in place of the usual laminated concentric striation shows a distinct radial striation.

Among the unusual stones must be classified those found in one of our cases. This patient had had repeated attacks of renal colic, and the function of the kidney had become greatly impaired, so that a nephrectomy was done. The kidney pelvis and calices were found choked with brownish, smooth bodies, more than 150 in number, varying in size from a small pea to a bean, with a distinct concentric lamination. These structures were very soft, and crushed

FIG. 304.—LARGE BILATERAL CORAL STONES FILLING PELVES AND CALICES OF BOTH KIDNEYS, AND MAKING PERFECT CASTS OF THEM. Note fracture of the stones at junction of upper major calices with pelvis. This is quite characteristic and is found in nearly all coral stones. It may be due to bending of kidney by respiratory movements. Not the normal looking kidney parenchyma $\frac{1}{2}$ natural size. (E.; J. H. H., Autopsy, Aug. 17, 1900.)

easily between the fingers. This type of stone has been fully described by Homer Gage and Howard Beal (*Ann. Sur.*, 1908, xlviii, 378). In their article is found a most interesting review of the pertinent literature. Their patient died two years after operation. Our own is still living nine years after operation, never having had any trouble with the remaining kidney.

So far as size is concerned, stones may vary from sand to immense structures. The very large stones are, as a rule, situated in the pelvis of the kidney. Some of our largest are shown in Figures 301, 302, 303, also 323, 354, and 359. Some immense stones have been described in the literature. Israel's largest stone was 17 cm. long and 9 cm. in circumference. Rovsing states that he has

had stones weighing 148 grams. Johnsen (*Berl. klin. Wchnschr.*, 1906, xliii, 1623) reports a stone 14.1 cm. long, its longest circumference 33.5 cm., and its smallest circumference 28.5 cm. The stone weighed 339 gr. J. Ramsay (*Intercolonial Med. of Australasia*, 1902, vii, 342) records a very large stone, and refers to the case of T. R. Jessop, where the stone weighed over 11 ounces; he also quotes Pohl (Allbutt's "System of Medicine," 1897, v, 440) as removing at post-mortem a stone weighing five pounds.

The shape of stones is largely determined by the factors of pressure and surroundings. This is well shown in the faceting of the multiple stones (Fig. 303), in the long, narrow stones sometimes found in the ureter (Fig. 317), and,



FIG. 305. — URETERAL CALCULUS PRESENTING A SMOOTH AND HIGHLY POLISHED SURFACE. Its color was the dark reddish brown of chocolate. (From Harvey Cushing, Sept., 1905.)

FIG. 306. — URETERAL STONE WITH GROOVED PASSAGE FOR URINE. Transverse section in upper figure. (P. F. Mundé, *Yale M. J.*, Nov., 1899.)

FIG. 307. — URETERAL CALCULUS FORMING A HOLLOW SHELL THAT IS OBVIOUSLY NO OBSTACLE TO THE EXCRETION OF URINE. (From J. W. Bovee.)

above all, in the wonderful coral stones (Figs. 304 and 359) which make such perfect moulds of the kidney pelvis and its calices. A stone of unusual appearance is that shown in Figure 305. Many ureteral stones become lodged and fixed and then grooved or hollowed out so as to allow free passage of the urine. Unique examples are shown in the specimens loaned us by Drs. Bovee and Mundé (Figs. 306 and 307).

In analyzing our cases to determine the frequency of single, of multiple, of unilateral, of bilateral, of right-sided, and of left-sided stones we were astonished to observe how closely our results agreed with those of other observers. In nearly half of the cases a solitary stone exists. Unilateral involvement is far commoner than bilateral. The right kidney is more often affected than the left. In our series a single stone was found in a little more than 47 per cent. of the cases. In over 44 per cent. of

our cases the stones were multiple, and in 9 per cent. 2 were found. Israel, in a series of 48 cases, found solitary stones in a little less than 46 per cent. of the cases; multiple stones in 54 per cent. The largest number of stones in any one of our series was 150. These were of the fibrinous character already referred to, but Gee has reported finding 1,000 stones in one kidney. In our series the stones were limited to one kidney in 79 per cent. of the cases. In 764 cases Küster found unilateral stones in almost 89 per cent. His cases were collected from the literature, and it is quite possible that some of those recorded as single were really bilateral. In his series, where the stones were limited to one side, the right kidney was involved in 57 per cent., and the left in 43 per cent. In our own, the right kidney was involved in 56.9 per cent., and the left kidney in 43.1 per cent., the figures thus being almost identical.

Heinrich Grau ("Die Häufigkeit der Nieren und Blasensteine," Inaugural Dissertation, Munich, 1904) has furnished a valuable statistical study from the Pathological Institute in Munich. During the period between January, 1896, and January, 1904, 90 cases were found of kidney and ureteral stones. In 16.6 per cent. the stones were bilateral, and in 83.4 per cent. unilateral.

The relation of stones to sex, age, race, and habits has constituted the principal part of several studies.

Sex.—There is no great difference in frequency of occurrence between the two sexes. Küster found stones in 368 males and 345 females; Kümmel, in 60 males and 41 females; Grau, in 52 males and 27 females. Our own statistics show 88 females and 7 males. Israel found 59 per cent. of his cases were women. Our own series does not form a basis of comparison, because we see far more women than men as patients. Grau, who calculated the proportion of stone cases in males and females in proportion to the total number of autopsies in each sex, found the percentage of occurrence in men was 1.32 per cent. and in women 8 per cent.

Age.—Unquestionably middle life is the time when most of the cases that come to operation occur. This is just contrary to the old idea that childhood and old age are the common periods for this condition. By far the commonest period, according to the combined statistics of Israel, Küster, and Kümmel, is between the ages of 20 and 40 years. In our series there were no cases under 10 years; 5 cases between 10 and 20; 18 between 20 and 30; 27 between 30 and 40, and 22 between 40 and 50, with 20 over 50. Grau found the commonest period in his cases was between 45 and 60. As his statistics were taken from autopsies, this is not surprising, and it gives us, in a sense, an idea of the average of life in this condition. It is of interest that the adult males in his series ranged in age from 15 to 94, and the adult females from 35 to 79. In 11 of his

stone cases, constituting more than 12 per cent. of the total, the stones were found in children. The percentage of occurrence in children in proportion to the total number of autopsies was .74 per cent. No less than 8 of these children were under one year of age, and the question arises as to whether he was dealing with infarcts or definite stones. Monsseaux (*Bull. méd.*, Paris, 1904, xviii, 391) reports from the literature 77 cases of kidney stones in children between the ages of 1 and 15 years. In 90 cases Grau found ureteral stones 20 times (22 per cent.). We found ureteral stones 20 times in 95 cases (about 21 per cent.).

Geographical Locality.—That certain localities favor stone formation in the kidneys has long been believed. In this country no statistics are available. Hirsch finds that, in Europe, Middle Russia, Holland, Italy, Hungary, eastern England, and western France furnish a larger proportion of cases than other portions of the continent. There is no question that the disease is very common in America, much more so than operative statistics would indicate. There is no definite evidence which points to any influence of atmosphere, soil, or water in causing stone.

Race.—Küster believes that the Jews are more liable to stone kidney than other races. Our own experience does not confirm his view, but the number of cases is too limited to draw any real conclusions. It is of interest to note that, in spite of the large negro population in Baltimore, and the fact that we have a number of negroes as patients in the clinic at the Johns Hopkins Hospital, not one of them has ever shown stone in the kidney.

Determining Factors.—The question as to what determines the formation of stones in the kidney cannot be answered at the present time. It has been suggested again and again that foreign elements in the urine, such as bacteria, blood clots, or shreds of tissue, may furnish the nuclei upon which stones are built. The reasoning is from analogy based upon the well-known fact that, if a foreign body gains entrance to and remains in the bladder for a long time, it becomes covered with an incrustation of salts, and forms a stone. Numerous cases are on record where bacteria, blood clots, shreds of tissue, parasites, such as the schistosoma hematobium, and filaria sanguinis hominis, have been found in the nuclei of stones. Nevertheless, such findings are the exception. Dr. Thomas R. Brown (*J. Am. Med. Ass.*, 1901, xxxvi, 1395), reporting seven cases of stone and infection in which he found bacteria in the nuclei of the stones, points out the frequency of stone formation when the infection is with organisms which split urea and cause alkaline urine. He notes also that the stones associated with infection are made up of phosphates and carbonates. In one of the stones worked up by Dr. Gordon gonococci were found in the nucleus.

FIG. 308.—HYDRONEPHROSIS AND HYDROURETER OF RIGHT KIDNEY DUE TO OBSTRUCTION OF URETER BY STONE ABOUT 10 CM. FROM VESICAL ORIFICE. The capacity of the pelvis and ureter in this case was 60 c. c. as measured by injection before operation. The drawing to the left shows external appearance. The tortuous course is characteristic of all distended ureters, and is due to increased length, with variable capacity for distention in different parts of the ureter. On palpation the calculus was felt as a hard body. Owing to thickening and inflammation about it, the stone seemed to be three times as large as it really proved. The drawing to the right shows the condition in section. The symptoms consisted of attacks of pain in the right side lasting for three years. Stone demonstrated by gouges on wax-tipped catheter. Function of kidney practically normal. Treatment: first operation, nephro-ureterotomy; removal of stone; dilatation of stricture through extra-peritoneal incision. Two months' relief. Second operation, nephro-ureterectomy, with complete and permanent relief. (Mrs. N. S., age 28. Gyn. Nos. 13453 and 13577. Dec. 13, 1907.)

There is no question that infection does favor stone formation; but there are many cases where infection has persisted for years and yet no stone formation has taken place; and likewise, in the large majority of stone cases, the nuclei do not contain bacteria, blood, or tissue.

Following Meckel's suggestion, that a catarrh of the urinary passages was

FIG. 309.—CHAIN OF POCKETED STONES EXTENDING SEVERAL INCHES DOWN URETER.
The large stone prevents the passage of the smaller ones above it. (From J. Deland.)

at the basis of stone formation, Ebstein demonstrated that in every stone, in addition to the crystalline part, there is a framework of albuminous nature. For some time after the publication of these studies his conclusions were given full credence. Later, however, the investigations of Moritz, Mendelsohn, and others proved that all precipitates in the urine contained an albuminous framework, thus robbing Ebstein's explanation of most of its interest. Since

FIG. 310.—ENORMOUS HYDRONEPHROSIS AND HYDROURETER WITH 47 STONES IN VESICAL END OF URETER. The symptoms were attacks of renal colic and intermittent hydronephrosis, extending over a period of more than 9 years. There were no symptoms referable to the bladder nor abnormal elements in the urine. Complete recovery followed operation. Note the grooved lowermost stone, caught in the vesical orifice, with one end projecting into the bladder and the other in the ureter. This prevents the passage of the stone itself and dams back the other stones, though it permits the percolation of urine into the bladder. (Mr. J. W. B., age 44, Feb. 25, 1905. From J. G. Sherrill and J. W. Long.)

Bramann, 1891, pointed out the frequency of stone formation in the kidney in cases of injury of the vertebral column, numerous confirmatory reports, as that of G. Seefisch (*Dtsch. Ztschr. f. Chir.*, 1908, xciv, 426), have been made. It would seem that this stone formation occurs independently of infection, which

invariably follows in the urinary system from injuries to the spinal cord. Rovsing has suggested that there may be a congenital or acquired diathesis in which an excessive amount of certain salts is excreted. It has been suggested in other quarters that food has an influence and that certain alkaline substances, particularly alkaline waters, predispose to phosphaturia; that grapes and tomatoes tend to produce oxaluria. Rheumatism and gout are said to predispose to the condition. Rosenbach (*Dtsch. Ztschr. f. Chir.*, 1911, cxi, 556) has produced stones in the kidney of rabbits and dogs by feeding them on oxamid, and shows that tying the ureter, cutting off the nerve supply, tying ar-

FIG. 311.—STONES IN KIDNEY ASSOCIATED WITH DISTENDED PELVIS AND CALICES. In the pelvis are one large egg-shaped stone and two smaller ones; one small stone shows in upper calyx. Note excellent preservation of cortex and marked peripelvic fat layer. $\frac{1}{2}$ natural size. (From J. Ernest Stokes.)

teries, and putting foreign bodies in the kidney all markedly favor stone production.

In summing up, however, it must be confessed that but little is known regarding the influence of these factors on stone formation.

PATHOLOGICAL CHANGES IN THE KIDNEY PRODUCED BY STONE.

Under exceptional circumstances a stone, even a very large one, may remain for a long time in the kidney and produce but slight alteration in its anatomical structure, as well as little influence on its functional activity. Sooner or later,

however, destructive changes of one kind or another are sure to set in. Obstructions to the outflow of urine lead to hydronephrosis (Figs. 308, 309, 310, and 311), a condition observed in about 20 per cent. of our cases. Heinrich Grau noted hydronephrosis in 14 out of 74 cases at autopsy. The dilatation varies from a slight dilatation of the renal pelvis to enormous distention. Not only the stone, but more frequently the pathological process it gives rise to, leads to the hydronephrosis. A very small stone in the ureter may lead to complete transformation of the kidney in this way (Figs. 312 and 313).



FIG. 312.—MASSIVE HYDRONEPHROSIS DUE TO STONE IN UPPER END OF URETER.
(Wm. Osler.)

Frequently a stone kidney will be found considerably enlarged, owing to a marked increase in its connective tissue, producing an interstitial nephritis. When this fibrous transformation has progressed further the kidney usually becomes smaller than normal. The condition of chronic interstitial nephritis in this connection is a very common one. Grau noted it in 30 cases out of 74 of those which he studied.

Israel has pointed out the fibrous fatty change which takes place in the capsule of the kidney and the surrounding fat. It is not an uncommon occurrence for the kidney to undergo complete degeneration and to be entirely replaced by a fibrous fatty tissue (Fig. 314).

One other change which is occasionally met with is cyst formation following the obstruction of a single calyx. Such a kidney is shown in Figure 285, except that, in place of stone, a tuberculous process represents the obstructive factor. The same condition was found in the specimen shown in Figure 315.

In addition to these changes, which occur when there is no infection, it is to be remembered that the presence of stone continuously predisposes to bacterial attack, a common and a serious complication. A higher percentage of infection is found in stone kidneys operated on than in those discovered by accident during post-mortem examinations. For instance, Grau found infection in 29 out of 74 cases. In our series there were 73 infected cases out of 99. The infecting organism may be any of the pus formers, and is not uncommonly the tubercle bacillus. When infection has once set in, any change from a mild pyelitis to complete destruction of the organ may take place.

Pyonephroses and large perirenal abscesses are very common (Figs. 315 and 359).

Changes in the opposite kidney not involved by the stone process are common. Legueu states that, in 38 cases where stones were present in one kidney, in only 4 was the second kidney absolutely normal. In our own series of 55 cases, even when there was infection of the

FIG. 313.—SECTION THROUGH KIDNEY SHOWN IN LAST FIGURE, SHOWING SIZE AND SITE OF STONES. Note complete destruction of kidney parenchyma. $\frac{1}{2}$ natural size.

one kidney, the other was apparently absolutely healthy in 23. One of the common changes in the second kidney, as the first one undergoes destruction, is a compensatory hypertrophy.

SYMPTOMS OF STONE IN THE KIDNEY

To the uninitiated, stone in the kidney invariably suggests attacks of pain in the side and the passage of blood in the urine. They are the well-known symptoms associated with kidney colic. We know, however, that they arise from many pathological conditions of the kidney beside stone, and that in many cases of stone they never occur. There are few kidney diseases in which such

variable symptoms arise as stone, but there are many cases of renal stone which never give rise to symptoms at all. On the other hand, there are cases in which some complication creates the symptoms, the case presenting the picture of a pyelitis, or of a pyonephrosis, or, occasionally, of a tuberculosis of the kidney. As the symptoms arising from such troubles, pain, fever, tumor, pyuria, increase of the leukocytes in the blood, are fully described in the chapters devoted to these subjects, they will not be gone into here. It seems the most simple plan

FIG. 314.—LARGE STONE IN PELVIS OF KIDNEY AND CALICES WITH COMPLETE DESTRUCTION OF THE KIDNEY. The parenchyma has been largely replaced by fatty tissue. The stone is fragmented as usual. Note that the large piece in the middle has the shape of a pelvis, while the piece above it probably originated in the upper calyx, now represented by a band of scar tissue. (From Hugh H. Young, Nov. 28, 1902.)

to consider the topics: renal colic, pains other than colic, hematuria, and anuria.

Renal Colic.—The colic due to stone in the kidney does not differ from that associated with other pathological conditions of the organ, and cannot be distinguished, either by severity, location, or radiation. It varies from a slight discomfort to veritable agony, which cannot be controlled by morphia. The duration of the pain varies from a few minutes to hours. The commonest type is that in which the pain begins in the loin and radiates downward along the course of the ureter toward the bladder, often to the ileum, sometimes to the leg, sometimes to the ovary or testicle. In more unusual forms the pain radiates toward the shoulder blade, or over to the opposite kidney. In some cases the pain remains localized in the kidney, and does not radiate at all. How many cases exhibit renal colic? Roughly speaking, about 50 per cent.

Forty-six per cent. of our cases gave a history of pain which was solely in the form of attacks; 11 per cent. of occasional attacks, but continuous pains. Dr. Hugh Cabot (*Am. J. Urol.*, 1912, viii, 1) found a history of colic in 54 per cent. of his 50 cases. Many cases which have one attack may, after the lapse

FIG. 315.—STONE IN THE PELVIS OF THE KIDNEY. Pyonephrosis of the lower pole and calices; cystic transformation of the upper pole, due to closure of the neck of the major calyx by scar possibly induced by friction of calculus. Only symptom, slight dragging pains in left side when on feet. Duration, one year. The right kidney was perfectly normal. Natural size. (Mrs. J. T. R., San. No. 2196, May 28, 1906. Age 56.)

of a month, show a continuous pain and no further attacks of colic. Just as the duration of the colic is a variable symptom, so is the frequency of the attacks. Sometimes months elapse, even years, between the single attacks. In other cases they may be of almost daily occurrence. It is well known that the passage of a stone down the ureter occasions kidney colic. On the other hand, a stone may exist in the ureter, as is shown in 5 of our cases, and yet never occasion attacks of pain. In many of our cases of stone in the pelvis of the kidney the pain has been present only in attacks; the proportion of pain in attacks, however, is considerably greater in ureteral than in kidney stones. Many cases where there are no evidences of obstruction to urinary flow still have attacks. This is true of large stones in the kidney pelvis where there is no hydronephrosis. It is another confirmation of the frequently observed attacks of renal colic due to some other cause than obstructed urinary outflow. During a severe attack of renal colic, in addition to the pain, there are often vomiting and nausea, and frequently some irritability of the bladder. Where infection is present the urine which has been purulent may clear up and marked fever develop. An interesting and common occurrence is abdominal distention, with severe pains in the abdomen and failure of gas or any material to pass by the bowel, so that the whole picture strongly suggests intestinal obstruction. Not a few such cases have actually been operated upon for intestinal obstruction. Israel has drawn especial attention to this clinical type.

Walking or active exercise may bring on attacks of renal colic; they may arise, however, without any such apparent mechanical cause. We have never observed a case of kidney colic on the opposite side to that in which the stone was present, when that kidney was normal. One finds frequent reference to this transferred pain in the literature, but most of these reports probably rest on insufficient evidence; for example, it would be quite possible for a large stone to be present in one kidney and give no symptoms, and for a small ureteral stone to be occasioning attacks of colic on the opposite side. We have had one case of obstructed ureter on the one side with severe colic, while on the other a large stone was present in the pelvis of the kidney. This patient was watched through the attack. The X-ray showed the stone on the one side, and an apparently clear kidney on the other. Immediately after the attack the stone was removed from the kidney by pyelotomy. This patient was well for several weeks, when another attack occurred, requiring opening and draining of the kidney which was the site of pain, and removal of the small stone from the ureter.

Fixed Pains.—Fixed pains, usually continuous, may be in the back, or in front over the crest of the ilium, or near McBurney's point, or its corresponding point on the left side. These pains vary greatly in severity, and are frequently

that one ureter is obstructed and the kidney a functionless organ on the other side. Israel, on the contrary, has advanced very convincing evidence of the view that sudden blockage of the ureter on one side can lead to a complete anuria of reflex origin in both kidneys. In his original series of 78 cases Israel met with this complication 5 times. Of these 5 cases, the ureter of one kidney was plugged with a stone in 2, the other kidney being completely out of function from previous disease. In 2 cases one ureter was plugged and the other kidney had ceased secreting, owing to reflex influence upon it. In one case the data were insufficient to show the exact condition of the two kidneys. Four out of the 5 cases at the time of operation were uremic. One of the cases which was successfully operated on was in coma at the time of the operation. In 4 of the 5 cases observed, there was definite disease of both kidneys, and in the fifth sufficient evidence was not obtained to determine whether there was disease of both sides. Evidence for reflex anuria is afforded in 2 cases by the fact that, after removal of the stone that obstructed the ureter, cystoscopic examination showed a return of flow from the other side at once. Israel goes further, however, and shows that reflex anuria may occur, not only from stone, but from obstruction of one ureter from any cause. Dr. Arthur Goetzel experimented on 3 dogs, and was able to produce a complete stoppage of secretion from both kidneys for a period of 65 minutes in one of the animals by stopping the secretion from one kidney through connecting its ureter with a manometer and bringing a pressure of 24 mm. of Hg. In the other two animals he succeeded in getting a marked diminution in the amount of urine secreted, but not a complete anuria. Rovsing has reported 3 cases in which he left clamps upon the pedicle of the kidney which he afterwards removed. Complete anuria existed in each case until the clamps were removed, a period of 2 to 3 days. F. S. Watson (*Am. J. Urol.*, 1910, vi, 18) refers to 3 cases; Albarran, to one, in which one ureter was plugged and the opposite kidney was opened, when secretion began both from the nephrotomy wound and through the ureter. This case is also referred to by Israel, as well as an exactly similar case of Ransohoff, of Cincinnati, and finally a case of Dr. Hugh Cabot, of Boston. In our series anuria at time of operation was observed in only one case, Mrs. S. M. M., age 61, Nov. 8, 1905. In this patient the left kidney, as shown by autopsy, was completely destroyed and its ureter closed, while the right kidney was pyonephrotic and the outflow of urine completely obstructed by a stone. A nephrotomy was done on the right side and a large amount of pus evacuated; the patient, however, survived the operation but 24 hours. A second case, in which there was complete anuria, was Mrs. E. M. M., age 52. The patient had a left-sided nephrotomy and removal of stone in 1897.

In 1905 a large pus kidney on the left side was opened and drained and stones removed. At this time all kidney tissues seemed to be destroyed. One year later, the patient was suddenly seized with pain in the right side and had calculous anuria. Nephrotomy was done on a right hydronephrotic kidney caused by obstruction in the ureter. The patient survived this operation about 9 months, dying in 1907. In addition to these 2 cases, 2 others gave histories of complete anuria for periods of 24 hours. The first was Mrs. J. B. S., December 8, 1903, age 42. This patient was shown by X-ray to have several large stones in the right kidney. The left kidney showed no stones. Cystoscopic examination showed both kidneys secreting normal urine. The function of the right kidney, as shown by urea, was about 3 times that of the left in a period of 10 minutes. No other functional tests were made. This patient gave a history of violent attacks of pain in the right side associated with anurias lasting for 24 hours. The right kidney was explored and 3 stones removed by nephrotomy from its pelvis. The patient made a prompt recovery from this operation and has since then had no attacks of colic and no anuria. The second patient, A. A. L., July 3, 1900, age 26, had a left-sided infected stone kidney. Six days before coming to the clinic she had a severe attack of pain in the left kidney associated with chills and fever and complete anuria. X-ray showed the trouble limited to the left kidney. Separate catheterization of the ureters was not carried out. Patient made a prompt recovery from a left-sided nephrotomy, and left the hospital well at the end of 3 weeks. Subsequent history is not obtainable, as patient has been lost sight of. In each of these cases we have what is apparently a true reflex anuria.

A complete anuria, lasting for over 24 hours, was observed in one other patient at the Cambridge Hospital, Cambridge, Md. The patient, Mr. B. C., age 50, was desperately ill at the time of operation. He had been a heavy drinker and had come into the hospital under the care of Dr. Brice Goldsborough for delirium tremens. While in the hospital, resting in bed, he was suddenly seized with violent attacks of colic in the right side, associated with passage of large blood clots through the bladder, and complete anuria. The right kidney was found greatly enlarged and tender. A diagnosis of stone kidney was made. At operation a large tumor of the kidney was found, evidently malignant. The pelvis was choked with blood clots. The condition of the patient precluded removal of the kidney, so that the operator contented himself with opening the pelvis, which was greatly distended, washing out the clots and packing it. There was no secretion from this kidney, but the other one promptly began to secrete normal urine. The patient improved greatly for a few days, and it was hoped that his condition would allow an attempt at re-

moval. He died, however, suddenly, from a profuse hemorrhage at the end of a week. This case is apparently one of true reflex anuria.

There is no case in the literature where, at autopsy, a stone has been found plugging one ureter while the kidney on the other side was healthy, and yet the patient during life has had a complete anuria and died in uremia. This fact alone would afford absolute evidence of reflex anuria and of death from such a condition. Kümmell (*Ztschr. f. Urol.*, 1908, ii, 329) has observed complete anuria six times in fourteen cases of double kidney stone. He says that he has never observed anuria except when both kidneys were thoroughly diseased.

DIAGNOSIS.

Previous to our modern methods, the diagnosis of stone in the kidney was a most difficult undertaking, as in a large measure it depended on the symptoms and the examination of the urine. As is already evident, symptoms closely similar to those of stone are furnished by a number of conditions in the kidney of an entirely different nature. It was only possible, therefore, to make a probable diagnosis in all cases except those in which stones could be felt in the lower end of the ureter, or, very occasionally, by palpation, in the kidney itself. The problem which confronts the diagnostician of to-day is to determine, in a suspected case, whether the symptoms are due to the kidney, and, after deciding that point, to determine if the disease is stone in the kidney or the ureter, or some other trouble. In the next place it is necessary to locate the position of the stone or stones in the kidney and ureter. Finally, it must be determined whether, and to what extent, the function of the kidney has been interfered with. It is essential to determine all of these factors not only about the suspected kidney, but also about its fellow. The diagnosis must rest, therefore, on:

A general examination of the patient, temperature, pulse, blood pressure, etc.

Examination of urine.

Palpation of the urinary tract, especially of the terminal portion of the ureters.

Ureteral catheterization, and estimation of the functional activity, and the morbid condition of the urine of each kidney separately.

Use of the wax-tip catheters to secure scratch marks.

X-ray pictures.

General Examination of the Patient.—It is through the general examination

of the patient that the physician determines what deleterious effects have been produced on the general system and health. In the end stages of renal insufficiency due to stone, one has the same symptoms which follow renal insufficiency from any other cause. There are, first, headaches, nausea, and vomiting, and, finally, coma; a high blood pressure is very commonly present. Kümmell draws attention to the lowering of the freezing point of the blood in cases of renal insufficiency due to stone. He considers that a freezing point of below 62° always indicates marked renal insufficiency. He points out that, in cases of calculous anuria, on the first day the freezing point of the blood may be normal but that within a day or two it rapidly falls.

The general examination affords much information regarding sepsis. In the acute stages of pyonephrosis there is always fever, and this may be very high; sometimes the fever is continuous and at other times shows an intermittent septic character, the typical curve ascribed to pyemia. Elevation of bodily temperature frequently occurs after a mild pyelitis, as well as pyonephrosis. On the other hand, in the old cases it is not uncommon to find large amounts of sacculated pus with no elevation of temperature. This matter is fully discussed under Pyelitis and Pyonephrosis.

In addition to the anemia found in many of the old cases one finds here the changes in the white blood cells described under Pyonephrosis and Pyelitis. In a general way the increase in the leukocytes and in the relative increase of the polymorphonuclear forms runs parallel to the temperature, that is, in cases of pyonephrosis. Occasionally, however, with a normal temperature, there may be an absolute count of from 12 to 18 thousand and the polymorphonuclear leukocytes show a relative proportion as high as 80 per cent. On the other hand, where we have merely an inflammation of the mucous membrane of the pelvis the temperature may rise to 103° or 104° and still no changes in the blood be observable. The nature of the infecting organism apparently has no influence in determining this matter, although pure tuberculous infection, even in the presence of large amounts of pus, does not show an increase in the polymorphonuclear leukocytes of the blood.

Examination of the Urine.—A careful study of the urine can afford useful information in diagnosing stone in the kidney, and frequently it is of greatest importance in drawing the observer's attention to the condition and pointing out the necessity of a complete urological examination.

One occasionally finds gravel or small stones in the urine of patients suffering with stone kidney, and, as already pointed out under Symptoms, this occurrence is not uncommon.

The presence of blood is a frequent and valuable sign. Immediately

after an attack of renal colic, blood cells are almost always present in the urine. Often in the intervals between attacks blood cells are present, and occasionally a hemorrhage of moderate degree may occur without pain and be due to stone. In general the blood which enters the urine from stone in the kidney is in small amounts, often determinable solely by microscopic examination. At the time of observation 30 per cent. of our patients showed blood in the urine on microscopical examination. We have not observed a case of severe hemorrhage due to stone in the kidney, although a number of such cases are on record. It is evident that if the kidney which contains stones, and in which the attack of colic occurs, is entirely shut off from the bladder the urine will be perfectly clear, even during and after an attack of colic. Whenever blood is present one is likely to find albumin by the ordinary clinical tests. Occasionally, albumin may be present in excess of the blood. The presence of such albumin and a history suggestive of stone is further confirmation of a probable diagnosis. The disease in which microscopic blood is most commonly found in the urine is Bright's disease. Attacks of colic, however, are not common in it, and the diagnosis is suggested by the abundance of casts. On the other hand, we have found casts quite as frequently in the urine of our stone cases as in those of essential hematuria and nephralgia, and they are also as common as in the tumor cases. Many cases of stone in the kidney during the quiescent period show no abnormal elements whatever in the urine. In those cases where, in addition to stones, infection is present in the kidney, pus and bacteria are constant accompaniments, provided the urine from the infected side gains entrance to the bladder. In certain cases of double kidney and of focal abscess in the kidney, a stone kidney which is infected may show no pus or bacteria. The amount of pus may vary from a few cells to great quantities.

The proportion of infection in some instances is quite high. In our series, out of 99 cases, 73 had been infected. Though the commonest infecting organism is the colon bacillus, we have observed the various forms of pyogenic cocci, the bacillus proteus, the bacillus pyocyaneus, the bacillus typhosus, and, in five cases, the tubercle bacillus.

Palpation.—Palpation in some cases gives conclusive evidence of stone in the kidney and in the ureter. Much more frequently the demonstration of increased size in the organ palpated and of tenderness merely indicates the site of the trouble without definitely showing its nature. During an attack of renal colic the renal region is nearly always very tender. This tenderness may extend over the entire side and, in many cases, over the entire abdomen. There is frequently marked muscle spasm of the affected side. In the intervals between attacks, and in those cases where there are no attacks, there may be ten-

derness over the kidney, or at some point in the ureter when the stone is ureteral. As noted under Pathology a large proportion of stone kidneys are enlarged ones, but exceptions to this rule may be found in the earlier stages and, occasionally, in the later, where the kidney has been entirely destroyed by atrophy. It has been the good fortune of some observers to palpate stones in the kidney during life. This is only possible when the patient is very thin, when the kidney is low and the stones very large. We have succeeded in doing this in 2 cases during the past year. In 98 cases, where careful notes were obtained, the kidney was palpable 46 times, and not palpable 52. Many of the cases in which the kidney was palpable were large pyonephroses. On the other hand, when the kidney is high—this is especially true in the male—it may not be palpable even when greatly enlarged. Percussion in such a case frequently shows a marked increase in dullness in the back on the affected side. It is especially interesting to note that we have been able to palpate the kidney in less than half the cases, when we remember that the normal kidney can be palpated in women in fully 50 per cent. of the cases. It would seem, therefore, that at times the adhesions about the kidney, due to the irritation of stone in it, actually make it more difficult to palpate than when it is normal. While, therefore, palpation of the kidney gives us but moderate information, palpation of the ureter, more particularly of the vesical end of the ureter, is most important, particularly in women. Stones can often be found by vaginal examination. The procedure is illustrated in Figure 318. We have made a diagnosis of stone in the ureter in this way in 8 cases out of a total of 20 with ureteral stone. One can readily palpate the ureter through the vaginal wall up to the level of the junction of cervix and corpus uteri; the stone in such a case can be pressed against the pelvic wall and felt as a hard body. Pressure on the stone often causes pain in such cases, and frequently irritates the bladder and excites a desire to urinate. Not infrequently a stone can be felt at one examination and not at the next, owing to its having slipped up in the ureter. When the stone is higher up in the ureter it can sometimes, especially on the left side, be felt by rectal examination.

Considerable information is obtained by using one hand in abdominal palpation, in addition to the palpating hand below. In the male, rectal examination is the only form of palpation that one can use.

Catheterization of the Ureters.—By catheterization of the ureters one can frequently positively demonstrate the presence of stone as well as its location, and likewise determine the functional activity of one or both sides, besides ascertaining, in cases of infection, whether one or both kidneys are involved.

Sometimes the examiner is fortunate enough to diagnose stone in the ureter

by a simple cystoscopic examination. This is true in those cases where a stone is present in the lower ureter and projects through the orifice into the bladder. Such an observation was made by Dr. Hugh Young (Fig. 319) and likewise by Dr. H. L. Newland (Fig. 320). We have observed a similar condition in one of our patients, Mrs. P. H., No. 916. History of attacks of pain

FIG. 318.—PALPATION OF URETERAL STONE THROUGH THE RECTUM. It is possible to reach a higher point in the ureter through the rectum than through the vagina. The procedure is therefore one of considerable value, especially when the stone is on the left side.

in right kidney over period of ten years. Stone in kidney removed by nephrotomy. Stone in ureter, which showed on cystoscopic examination, removed intravesically. In another case, Mrs. R. A., age 45, April 17, 1902, the stone did not show in the bladder, but the calculi in the lower part of the ureter caused a prolapse of the ureteral wall, making a little hard colliculus in the bladder. The calculi and the operative procedure employed for their removal are well shown in Figures 371, 372, and 373.

In addition to the appearance of the stone itself and its protuberances, as in the case described, it is quite common in the infected cases to observe the reddening and irritation due to inflammation around the orifice of the affected side, similar to the conditions observed in tuberculous kidneys.

By catheterization of the ureters the diagnosis is still further advanced. In the first place, if the stone is in the ureter, there may be an absolute obstruction

FIG. 319.—STONE PROTRUDING FROM URETERAL ORIFICE INTO THE BLADDER. Exposure through suprapubic incision, and removal by slitting the ureteral orifice. A smooth stone would probably have passed spontaneously. Note the rough crystalline surface of this calculus. (Operation by Hugh Young, Apr. 16, 1905.)

to the passage of the catheter on the affected side. The catheter is sometimes caught in a stricture and firmly held. If catheters are introduced into both ureters at the same time, and the one goes all the way to the kidney, while the other goes only to the obstruction, one gets a graphic illustration of how much farther one enters than the other by drawing them out simultaneously. As the two kidneys are usually equidistant from the bladder, it is possible to tell how far the ureteral stone lies from the kidney. It is also easy to show by actual measurement how far it lies from the ureteral orifice (Fig. 321). When the

stone is in the kidney the catheter gives no direct evidence as to its presence unless the shellac is scratched off or, as has happened in a few cases, a piece of stone is caught in the eye of the catheter and removed. It is of interest to note here that the development of the wax-tipped method of determining stone originated in an experience of one of us (H. A. Kelly) in the case of Mrs. R. B. W., August 18, 1895. The appearance of the catheter and the stone that scratched it are shown (Fig. 322). In this case the introduction of a catheter, in addition to allowing the escape of a small quantity of purulent urine,

FIG. 320.—PROLAPSE OF VESICAL END OF URETER INTO BLADDER, DUE TO STONE. (From H. L. Newland, March 19, 1906.)

also on withdrawal showed the catheter scratched and a small particle of stone in its eye. Within the next year scratch-marks were definitely obtained in the wax coating which we had then begun to employ. In passing, it is of interest to note that in two subsequent cases, stones, or rather fragments of stones, were found in the eyes of catheters which had been passed into the ureters. One of these was in the case of Mrs. L. L., February 23, 1907. The patient had a large calculus in the pelvis of the right kidney, which was removed subsequently by nephrotomy. Another case was that of Mrs. P. H., March, 1900, where a small fragment was brought down by the catheter. Occasionally one obtains a grating sensation on striking the stones with the catheter.

It must be borne in mind that several conditions may cause the obstruction of the catheter in the ureter, and the meeting of such an obstruction by no

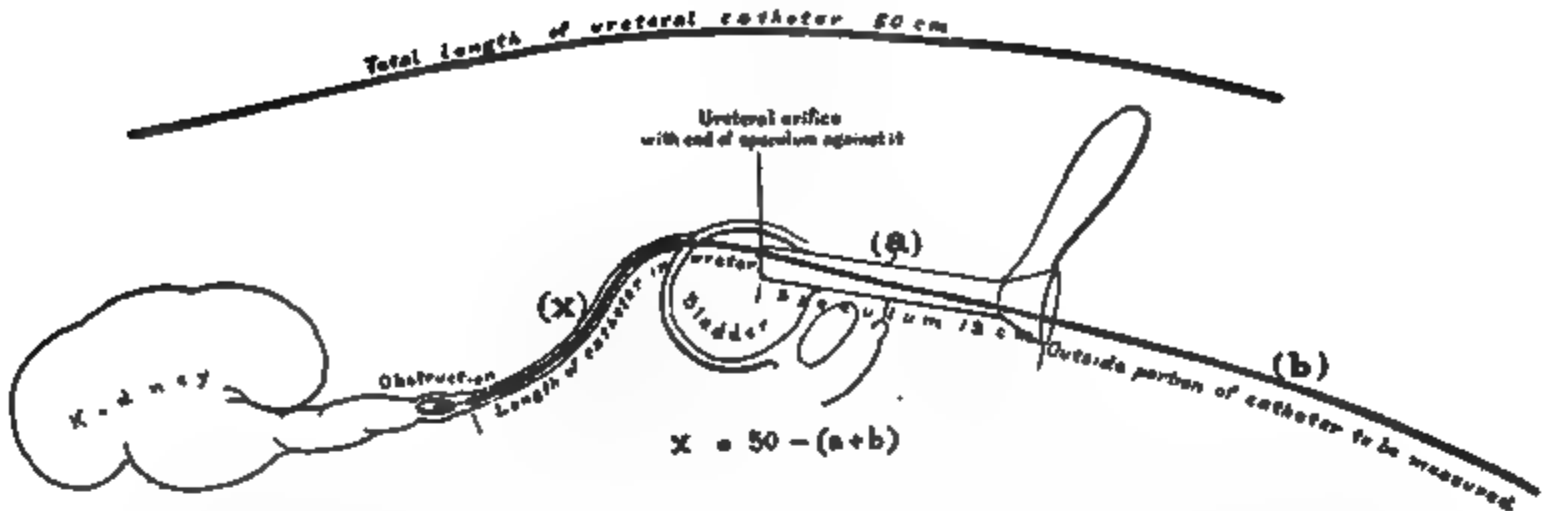


FIG. 321.—DETERMINATION OF THE DISTANCE OF AN OBSTRUCTION IN THE URETER FROM THE BLADDER. Let x represent this distance, and 50 cm. the length of the catheter. By deducting the length of the speculum, plus the length of the catheter outside of the speculum, from 50 cm. we have the value x , or the distance from the vesical orifice of the ureter to the obstruction, which, in this case, is a stone in the ureter.

means positively indicates stone. This is the case in ureteral strictures due to previous ureteritis, tuberculosis of the ureter, etc. Indeed, in some of the old tuberculous strictures one may actually obtain a gouging of the wax-tip. It is well, too, to recall that kinks and folds in a ureter which is normal may lead to obstruction. This is by no means an uncommon occurrence. In most cases,

FIG. 322.—GOUGED RENAL CATHETER HOLDING IN ITS EYE A SMALL FRAGMENT OF STONE. a shows catheter and stone, actual size; b, gouged tip of catheter, 9 times magnified; c, fragment of stone, showing plainly the whitish surface of the fracture, 18 times magnified. These specimens are of great interest in that they led to the conception and development of the wax-tipped method. The gouges shown are in the shellac covering of the catheter. The patient was referred to me by N. S. Davis and was subsequently operated upon by the late F. Henrotin, confirming the diagnosis. (Mrs. R. B. W., San. No. 126, Sept. 25, 1894.)

by varying the point and size of the catheters used, such conditions can be differentiated from true strictures. It is of interest to note here, too, that in

FIG. 323.—BILATERAL STONE KIDNEY; LARGE CORAL STONE FILLING PELVIS AND CALICES OF RIGHT KIDNEY. The left is a double kidney with two ureters, the upper pelvis and calices were filled with a stone and small fragments of calculi were present in the ureter. The lower pelvis and ureter were clear. The X-ray showed a stone shadow in the right kidney but none in left, because the plate was placed too low. Note upper limit of skiagraph indicated by the rectangle. Furthermore, the catheter which entered the left ureteral orifice passed into the lower pelvis of this kidney and clear urine was obtained; if it had been introduced only a few cm. from the vesical orifice, pus would then have been found and suspicion aroused. (Case of H. H. Young, 1901.)

these cases the function of the kidney is not in the slightest impaired, either in reference to the rhythmic spurting or the amount of substances excreted.

By means of the ureteral catheter the urine can be collected separately from each kidney, and it can be determined just what elements, normal and

A

FIG. 324.—RENAL CATHETER ENTERING PELVIS OF KIDNEY AND STRIKING A LARGE BRANCHED STONE. A wax-tipped catheter under such conditions will show gouges.

pathological, are present on either side. In addition to the chemical and bacteriological methods, and microscopical examinations, ordinarily in use, the relative function of the two kidneys can be studied. In the chapter dealing with the Functional Methods of Determining the Activity of the Kidney the details of these procedures are described, and it suffices to note here that every

degree of change, from no interference with the function to complete destruction of the kidney, may be observed.

The functional tests alone can give no positive evidence of either the pres-

FIG. 325.—WAX-TIPPED CATHETER SCRATCHED ON BOTH SIDES. (See Fig. 370.) Calculous pyonephrosis, left, hydronephrosis and hydroureter of right kidney, the latter due to a small stone in the ureter just above the crossing of uterine artery. The patient had recurring attacks of colic in both kidneys at irregular intervals of one month to two years, over a period of eleven years. Both kidneys active; the left showing colon bacilli and pus in urine. Both sides furnished scratch-marks on the wax-tipped catheters. Death about 5 months later from intestinal obstruction. (Mrs. E. J., Gyn. No. 7762, age 32; May 23, 1900.)

ence or absence of stones. What they show is the functional activity of the kidney. They may suggest that stone is present by some change in function in conjunction with the history and findings, and they do afford data which will guide the operator as to the best and safest operation.

Another point which the renal catheter makes it possible to ascertain,

through injection of the pelvis with sterile salt solution, is whether or no there is a dilated pelvis; in other words, whether there is a hydronephrosis. In our series, where this measure was accurately carried out, this point was determined

FIG. 328.—WAXING TIP OF RENAL CATHETER. The tip of the catheter is dipped in melted wax which hardens on exposure to air. The proper extent of waxing the tip is shown in the catheters to the right. In certain cases it is of advantage to place strips of wax along the catheter, as shown, or to wax the entire catheter.

before operation in 20 cases. The knowledge of such a condition is often of value in interpreting markedly dislocated shadows in X-ray pictures. It is also very helpful to confirm the location of shadows in the X-ray pictures by injections of collargol or silver iodid. In stone cases, as in all other kidney

conditions, the question of determining whether the kidneys are the cause of the trouble frequently arises, and there is nothing which affords such direct evidence as the pain produced by injecting kidneys. In a large number of our cases this procedure was carried out, and it has always given positive evidence that the kidney is the organ involved. The technique and description of this procedure is given in Chapters X and XVI.

In connection with the ureteral work certain anomalies of the kidneys should be kept in mind, especially that of double pelvis and bifurcated ureter. We met with such a case recently, where there were stones in the lower pelvis on both sides. On the right side, in addition, there was pyonephrosis of the lower pelvis. The X-ray showed stones in both kidneys and remarkably low down. The bladder urine contained an abundance of pus cells. On catheterizing the ureters the urine from both sides was clear and contained no pus on microscopical examination. The bladder itself looked perfectly normal. This patient was Mrs. J. P., February 18, 1910. Without the thorough examination of the bladder in such a case a diagnosis of vesical pus would have been made. A similar case has been observed and reported by Dr. Hugh Young. The conditions in his case are well shown in Figure 323. It should also be borne in

FIG. 327. — WAX-TIPPED CATHETER. Actual size. Note long eye. In waxing, care must be taken not to obstruct this.

mind that occasionally the foci of infection, located perhaps in a single calyx, become closed off and leave clear urine for a time.

The Use of the Wax-tipped Catheter to Secure Scratch Marks.—Before the introduction of the X-ray, which it preceded by several years, this was the solitary method for positively diagnosing stones in the ureter and the kidney. The method was first reported by H. A. Kelly (*Medical News*, 1895, lxxvii, 593). Since its introduction it has become one of the most successful methods employed in his clinic, and has, on several occasions, afforded evidence of stone when all other methods, including the X-ray, have failed to show the condition. The wax-tipping of the catheter does

FIG. 328. — FLAT FACET ON WAX-TIPPED CATHETER, DUE TO RUBBING SIDE OF SPECULUM. Note difference in appearance between scratches and gouges due to striking against a stone.

not interfere with its use for the other examinations, and it is a regular routine to use a catheter so waxed in each new catheterization. The actual method by which the scratches are produced is shown in a schematic way in Figures 324 and 325.

The wax mixture is composed of dental wax and olive oil mixed together and melted in the proportions of two parts wax and one part oil. The propor-

FIG. 329.—METHOD OF EXAMINING WAX-TIPPED CATHETER. Figure to the right shows method of examining wax-tipped catheter with magnifying-glass after its removal from kidney. Figure to the left shows the appearance of wax after scraping against a stone in the pelvis of the kidney.

tion of wax may be increased in very hot weather. This mixture is poured into an open bottle holding an ounce, or into an ordinary test-tube, where it quickly solidifies. The waxing of the catheter is carried out by first melting the wax in the bottle and then dipping the point of the catheter into it, taking care not to occlude its eye. The wax should be distributed in an even, smooth coat, such as shown in Figures 326 and 327. It hardens on the catheter immediately. Such a coating readily scratches when it strikes a stone. Before using such a catheter it should always be examined to see that the wax is evenly distributed. It is an easy procedure, with the open-air cystoscope and the patient in the knee-breast posture, to introduce such a catheter into the ureter.

This must be done with care to avoid touching the side of the speculum. Striking the speculum makes a flat, smooth facet, which cannot be mistaken for the gouge of the calculus (Fig. 328).

After introducing the catheter into the ureter it is stripped off the stylet



FIG. 330.

FIG. 331.

FIG. 332.

FIG. 333.

FIG. 334.

FIG. 335.

FIG. 330.—GOUGES ON WAX-TIPPED CATHETER FROM IMPACT AGAINST A URETERAL STONE (Mrs. H.)

FIG. 331.—WAX-TIPPED CATHETER DEEPLY GOUGED BY IMPACT AGAINST STONE IN RIGHT KIDNEY. A skiagraph was considered impossible on account of very thick, fat, abdominal wall. The symptoms were frequent attacks of colic in the right side. The wax-tipped diagnosis was not confirmed by operation, as the patient refused to have anything done. (Mrs. D. W. Gyn. No. 9951. Oct. 6, 1902.)

FIG. 332.—GOUGED WAX-TIPPED CATHETER. Stones in both kidneys. The scratch-marks in this case were caused by a stone in the pelvis of the left kidney. (Miss F. S. Gyn. No. 8458. June 14, 1902.)

FIG. 333.—GOUGED WAX-TIPPED CATHETER MAKING POSITIVE DIAGNOSIS WHERE X-RAY PICTURES HAD FAILED TO SHOW STONE. The symptoms were repeated attacks of colic in the left kidney, over a period of four years. Mild colon bacillus infection of the pelvis of the left kidney; hydronephrosis of 60 c. c. Functional activity of two sides equal. Seven stones were found in the pelvis at operation. (Mrs. J. A. S., Gyn. No. 11104, March 16, 1904.)

FIG. 334.—DEEPLY SCRATCHED WAX-TIPPED CATHETER, DUE TO IMPACT AGAINST A STONE IN LEFT URETER. This stone was subsequently passed spontaneously. (Mrs. S. W. Gyn. No. 11220, March 1, 1904.)

FIG. 335.—GOUGED WAX-TIPPED CATHETER, FROM IMPACT AGAINST STONE IN PELVIS OF RIGHT KIDNEY. Single large stone in pelvis of right kidney occasioning symptoms for two years, complicated by mild proteus infection. Treatment, nephrolithotomy. Prompt recovery. (Mrs. J. B. R., San. No. 878, Jan. 30, 1900.)

and pushed inward until it reaches an obstruction which may be the pelvis of the kidney. Here it is our custom to move it gently to and fro two or three times. The catheter is left in place while the various tests are being made. When these are finished we have the patient rise up on her knees with the body vertical, and pull the catheter downward. This is done in order to make any stone drop to the ureteral orifice of the pelvis of the kidney and come in contact

FIG. 336.—GOUGED WAX-COATED CATHETER AND THE STONE WHICH CAUSED GOUGES. The catheter to the left is the same as that to the right; in the one, the tip is shown and in the other a part of the catheter 24 cm. from tip. The larger picture of the stone is magnified to the same degree as the catheter; the smaller picture shows the stone three-quarters natural size. The stone in this case was embedded in the wall of the vesical end of the ureter. The symptoms were severe attacks of renal colic extending over four months. The pain was referred to the kidney. The stone was removed by extra-peritoneal abdominal incision. (Miss I. McB., Nov. 25, 1905.)

with the catheter as it is withdrawn. The patient can then resume the knee-breast posture and the catheter is steadily drawn outward. The vulva is held apart so as to avoid contact with the catheter. The withdrawn catheter is then taken to a bright light and examined with a lens which magnifies from 3 to 5 diameters. The scratch-marks, when present, are then readily observed (Fig. 329). They vary greatly in appearance and in general situation. Various types of scratching are shown in Figures 330-341. It is possible to deter-

mine the position of the stone in the ureter in those cases where the catheter passes the stone by waxing the catheter in little strips from its point downward, or, as Dr. John A. Sampson suggests, by coating the entire catheter. In

FIG. 337.

FIG. 338.

FIG. 339.

FIG. 340.

FIG. 337.—GOUGED WAX-TIPPED CATHETERS. Note different appearance of gouges due to impact against same stone by two catheters, introduced on separate occasions. Duration of illness, 18 months. Severe attacks of pain in right side; colon bacillus infection of right kidney; cystitis. Right nephrolithotomy. Prompt, permanent relief. (Mrs. L. L., San. No. 1275, Dec. 5, 1901.)

FIG. 338.—DEEPLY GOUGED WAX-TIPPED CATHETER, FROM IMPACT AGAINST STONES IN PELVIS OF KIDNEY AS WELL AS IN URETER. Both kidneys were secreting approximately equally, and normally, in spite of a moderate hydronephrosis of the left kidney. Nephrotomy and removal of one large stone from the pelvis of the kidney. Subsequent to operation, the small calculus shown in Fig. 316 was passed spontaneously. This patient has remained well. (Mrs. M. M. G., Gyn. No. 7455, Dec. 23, 1899.)

FIG. 339.—GOUGED URETERAL CATHETERS OBTAINED FROM CATHETERIZING THE TWO KIDNEYS. In this case both pelves contained stones, the left kidney was entirely functionless, the right kidney infected with streptococcus. Stones in right kidney removed by nephrotomy. Death three weeks later from uremia. (Miss A. C. T., Gyn. No. 7648, March 17, 1900.)

FIG. 340.—GOUGES IN WAX-TIPPED CATHETER DUE TO STONE IN RIGHT URETER. (Mrs. R. D., U. P. I., Apr., 1902. From W. W. Russell.)

such a case a ureteral stone will scratch from the tip all the way down to the point on the catheter which is in contact with the stone, when the tip is in contact with the pelvis of the kidney. The point of the catheter which is in the vesical orifice of the ureter can likewise be marked.

This wax-tip catheter method has proved of aid in some cases of retrograde catheterization from the pelvis of the kidney after nephrotomy. Such a case was observed through the courtesy of Dr. Wm. Halsted, October 26, 1900. The patient, a very stout woman, had a urinary calculus, and Dr. Halsted did a nephrotomy on the left kidney. A wax-tipped catheter was passed into the ureter through the pelvis of the kidney down toward the bladder; upon its withdrawal the catheter showed definite scratch-marks (Fig. 342), and vaginal examination demonstrated a stone in the vesical end of the left ureter. At Dr. Halsted's request a longitudinal incision was made through the vagina, the ureter opened, and the calculus removed (Fig. 343).

We have never employed the wax-tip method with the male. It would be quite possible to use it with an open-air cystoscope in the knee-breast posture or with the cystoscope of Luys or any long tube. Dr. W. A. Ayers (*Am. J. Surg.*, 1908, xxii, 330) describes the technique for the use of this method with his cystoscope and records its successful use in 2 cases where all other methods, including the X-ray, had failed.

FIG. 341. — APPEARANCE OF CALCULUS WHICH CAUSED SCRATCH-MARKS SHOWN IN FIG. 340. $\frac{3}{8}$ natural size.

The value of the method is great. It gives positive evidence, it is easy of application, requires no expensive apparatus, nor consumption of time, and can easily be carried out at the same time as the other examination by the ureteral catheter. It sometimes gives positive results when the X-ray fails. It sometimes happens that a stone may be present in a pocket in the ureter, so that the catheter passes it without contact. More often there is an obstruction below the stone which prevents the catheter reaching it. There are many cases in which the stone is so situated in the parenchyma of the kidney or in one of its calices that it is not reached. Occasionally even a stone in the pelvis may escape scratching. Out of 51 cases we have accurate notes, of which the wax-tip was positively scratched in 41. In 10 cases there was no scratching. Of these 10 cases, 4 were ureteral stones in which the catheters could not be pushed as high as the stone on account of stricture or fold in the ureter below it. In one case, already referred to, where the stones were of the fibrinous type, they were too soft. In three there was a large pyonephrosis, and in only two, a free stone in

the pelvis of moderate size. In two cases scratch-marks were obtained by the catheter coming in contact with old strictures in the ureter having calcium salts deposited in the stricture.

The X-ray.—The use of the X-ray is indispensable and affords the most valuable information as regards the presence, size, and location of stones, and no case should be considered satisfactorily investigated until complete X-ray pictures are obtained of both kidneys and ureters. It should be borne in mind, however, that the technique of the skiagrapher must be of the best, that poor X-ray plates may be worse than none, and that the interpretation demands experience and judgment. The technique for taking stone pictures, as well as the method of interpretation, is fully gone into in Chapter XII.

FIG. 342.—GOUGED TIPS OF WAXED CATHETERS, DUE TO STONE IN VESICAL END OF RIGHT URETER. The catheter to the left was obtained before operation by catheterization of the ureter through the bladder. That to the right was done at the time of operation by retrograde catheterization from the pelvis of the kidney downward, after opening the renal pelvis. The stone was removed through a small vaginal incision. (Mrs. M. H. R., J. H. H., Gyn. No. 32500, Oct. 26, 1900.)

The progress of stones which are being passed in the ureter has been brilliantly studied by Leonard, and here, too, the use of the X-ray is almost indispensable. The general tendency of X-ray specialists is to consider that, if the picture is properly taken, every stone will be demonstrated on the plate. The experience of various operators does not entirely confirm this, but there is no question that a good X-ray picture will show most stones. J. F. Smith (*Ann. Surg.*, 1904, xxxix, 748) reports 27 cases which were examined by the X-ray. In each case in which stones were found on the plate their presence was confirmed by operation. In 13 cases no stones were shown on the plate and none were found at operation; in one case the picture was doubtful. Kümmell states

that X-ray plates have practically always given conclusive information in his cases. In 91, where stones were present, the X-ray pictures showed the exact location and the number of stones; in an equal number of cases, where the X-ray was negative, the operation showed that there were no stones. Excellent examples of X-ray plates showing stone are presented in Figures 344 and 345. For full details showing location and appearance of stones see Chapter XII.

Hugo Neuhäuser (*Folia Urologica*, 1909, iv, 351) has contributed a most

interesting report on 245 cases from James Israel's clinic. After praising the X-ray as an indispensable method of diagnosis, he states that it may fail to show stones, in both fat and thin people, and also when the stone is either a phosphate or a urate. This failure of the excellent X-ray plates to show stone has been met with a number of times. He reports in detail three cases where the X-ray failed and yet the operation showed stone. In addition to these failures to show stones when present, the author shows the skiagraphs of several cases where shadows were apparent, but proved to be due to other diseases of the kidney. This type of false evidence obtained by the method is well known, and can usually be interpreted. He reports 2 cases, however, in which the kidney was found perfectly normal at operation, though the X-ray had shown definite stones.

Our own experience inclines us to agree with the findings from the clinic of Israel. During the last year we had one case of stone in the ureter almost as large as the end of an adult thumb; the stone was phosphatic and situated at the level of the sacroiliac joint on the left side. This case was Mrs. J. H. R., June 8, 1910. A splendid X-ray plate showing the detail of the bones and the psoas muscle was obtained, and yet no shadow was cast by the stone.

In another case, Mr. A. P., age 40, the patient had never had any pain in the kidneys, but had marked vesical distress, and a continuous pyuria due to the colon bacillus. The cystoscopic examination showed a fairly normal bladder. Urine was obtained from each kidney separately, and the two kidneys were found to be acting equally. The urine from both showed pus, red blood cells, colon bacilli, and casts. The total output of indigo-carmin in 2 hours amounted to only 3 per cent. The blood pressure was 150. The X-ray picture seemed to show a small stone in the right kidney and a large one filling the pelvis on the left side. At operation a stone was found on the right side, but there was none on the left side; both kidneys were small, and showed marked signs of chronic interstitial nephritis. The fat around both kidneys, particularly the left, was very fibrous and densely adherent to the pelvis. There was no pyonephrosis.

In another case, Miss F. S., October, 1903, the X-ray seemed to show stone

FIG. 343.—THE URETERAL STONE WHICH SCRATCHED CATHETERS SHOWN IN PRECEDING FIGURE. The smaller figure above shows the calculus natural size, the lower one, five times magnified. The flattened surface shown in center of figure is the result of a fracture and indicates that this stone is a piece broken off from another.

in pelvis of kidney, but operation showed merely an infected hydronephrosis, holding 50 c. c.

In another case, Mrs. J. A. S., March 16, 1904, operation showed the pelvis

FIG. 344.—SHADOWGRAPH OF RIGHT KIDNEY, SHOWING A LARGE STONE. This patient had had only gastric symptoms. (Taken Jan. 22, 1912.)

of the kidney to contain 7 stones. The wax tip in this case was positive, but the X-ray plate showed nothing.

In another case, Mrs. J. O. M., February 6, 1906, there was a history of attacks of pain in the left kidney and pus in the urine. Separate catheterization

of the kidneys showed that the urine from the right side was normal, while that from the left side contained colon bacilli and pus. The two kidneys were secreting equal amounts of urine, but the amount of urea on the right side was

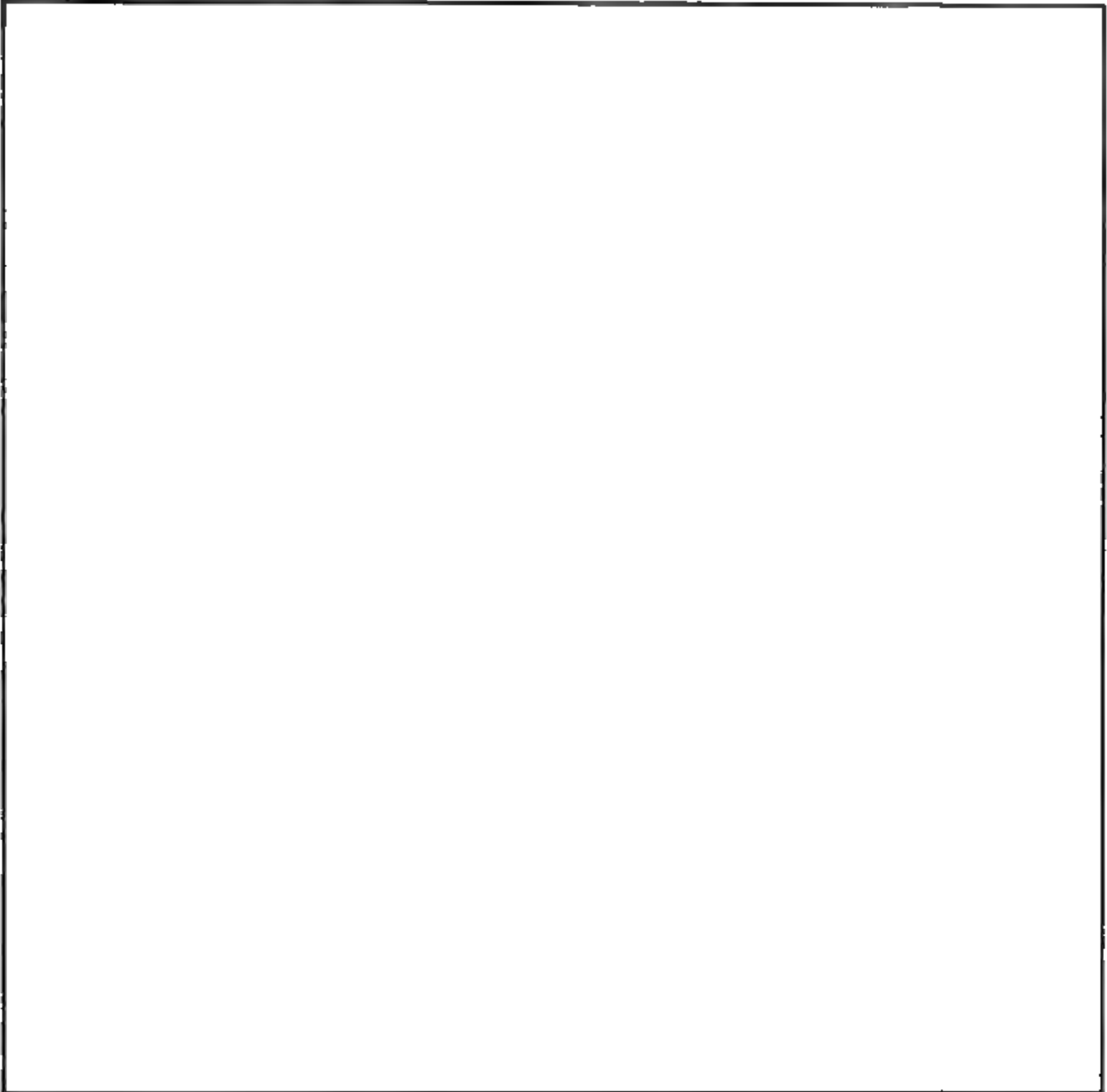


FIG. 345.—SKIAGRAM SHOWING IMMENSE STONE OCCUPYING PELVIS AND CALICES OF THE KIDNEY. (Mrs. S. A., June 27, 1911.)

five times that on the left in a ten-minute collection. The X-ray plate was good, and, in the words of the skiagrapher, positively demonstrated that no stone was present. The symptoms, however, were so suggestive that operation was carried out, and a small stone removed from the upper part of the ureter.

The ureter was considerably thickened above the stone. This patient made an uninterrupted convalescence, and has been quite well since the operation.

In still another case, Mrs. E. G. W., January 12, 1903, the X-ray showed no stone in the left kidney. The patient had been having repeated attacks in the left back for a year and a half. The left kidney was found to be secreting actively, but the urine showed pus and colon bacilli. The same condition was found on the right side. There had never been any pain in the right kidney. The wax tip was positive on the left side, negative on the right. The X-ray showed no stone on the left side, although at operation a large stone was removed from the pelvis, which also contained pus. On the right side the X-ray suggested a stone. No operation was done on the right side; patient returned to the hospital later, October, 1908, when the X-ray showed 2 stones in the kidney, one the size of a pigeon's egg, one smaller. At operation several small stones were found in this kidney.

In 50 cases where the X-ray has shown stone, they have been found at operation. In quite as many cases, where operation was done for other reasons, and where stone was not present at operation, the X-ray plate had shown beforehand that they were not present. All of this goes to show that, while the X-ray affords the most valuable of all methods of diagnosing stone, it is not to be entirely relied on; in some cases, it fails to show stones which are present, while in others, it seems to show stones which are not present. No examination, however, of a kidney is complete without this aid, and it often affords positive evidence of the presence of stone when no other method does so.

The foregoing remarks were based upon our views and experiences up to within the last year, but with the development of the art of skiagraphy there has resulted such improvement that, provided a perfect plate showing the outline of the kidney is obtained, it seems likely that all stones will be shown. This matter is fully treated in Chapter XII.

Treatment of a calculus in the urinary tract is either expectant or surgical.

EXPECTANT TREATMENT.

Expectant treatment is justified when the patient is not suffering much and the stone present is a small one, which may be expected to escape spontaneously.

A foreign body (stone), lodged at any point on the urinary tract, is always a source of danger, a sword of Damocles hanging over the head. A stone may grow in size, cause infections and hemorrhages and, in the upper urinary tract, prove an obstruction to the outflow of urine (anuria). In this way it is liable

to become a source of destructive changes in one or both organs whose integrity is of vital importance to the economy.

Most calculous patients suffer from more or less discomfort or sharp attacks of pain, which are peculiarly wearing, and sooner or later impair the health. It is also not without significance that tuberculosis and carcinoma are found associated with calculi. For these reasons every case demands serious consideration.

Various hygienic, dietetic, and medicinal measures have been advocated to prevent the formation of stones in the urinary tract. Most of these procedures have been directed against the accumulation of uric acid in the urine. The meats are reduced to a minimum. Tea, coffee, and chocolate are contraindicated. Alcohol is forbidden. The patient is advised to lead an active life.

Among the drugs advised are bicarbonate of soda, gr. 15, three times a day, urotropin, gr. 10 to 20, three times a day, and piperazin, gr. 10, three times a day.

The use of diuretics and the drinking of large quantities of water are universally urged.

While not attempting to deny the value of such measures, we must confess to having had but little encouragement from their use, and we believe it is very questionable whether stone formation can be controlled by following them.

All ureteral calculi by no means demand surgical treatment. C. L. Leonard, with perhaps the largest experience in this country in the X-ray detection of calculi, believes that in about 50 per cent. of the cases of urinary lithiasis presenting marked symptoms the natural forces are capable of expelling the calculus (*J. Am. Med. Assoc.*, 1909, lvii, 289). Leonard points out the fact that the apparent increasing frequency of ureteral calculi is in reality due to their readier detection by the X-ray, which furnishes an accurate method of diagnosis and at the same time affords a rational basis of differentiation between cases demanding immediate operation and those in which an expectant conservatism under strict supervision may reasonably be expected to result in the passage of the calculus by the natural channels. The calculi which may be left to nature, intelligently supervised, are those of small size—not much larger than the lumen of the ureter—which the successive attacks of pain are evidently forcing to a lower level; in other words, in which a sufficient *vis a tergo* is developed to drive the calculus on and out. Occasionally very large stones are passed. Such a one is shown in Figure 317. The supervision which renders this method of treatment safe must also observe by cystoscopic examination that there is no persistent anuria due to a blockade of the ureter, no

marked fever, and, most important of all, no acute infection of the urinary tract.

While waiting for the calculus to pass, the pain may be relieved and the spasm relaxed by morphia with atropin, keeping the patient in bed, giving enemas of water as hot as can be borne, and making local applications of hot water poultices, at the same time giving urotropin, say 5 gr. every 2 hours, after or during the attack. By drinking an abundance of water, preferably carbonated water, and using buttermilk as a diet, the increased urinary secretion serves to promote the progress of the calculus toward delivery. Although this treatment applies to most small ureteral calculi, it must at the same time be remembered that even tiny calculi may be lodged persistently at any point in the ureter. We have had to dig a calculus out of the ureter at its renal end, and in another case tear a little spiculate calculus not more than 5 or 6 mm. in diameter out of the vesical end of the ureter.

Sometimes a patient who has passed one small stone will, at irregular intervals, be taken with attacks of pain, passing stones, as a rule, similar in size and character. In all these cases the association of a competent urologist with the X-ray expert is earnestly advised.

INDICATIONS FOR OPERATIVE TREATMENT.

If the patient is compelled to lead an active life, and attacks of pain are brought on by exercise, or if there is blood or pus in the urine, or if the stone is a large one in any part of the urinary tract, it should be removed surgically at the earliest convenient opportunity. The general rule may be safely laid down, always operate for fixed stones and for stones which cannot reasonably be expected to pass down and escape *per vias naturales*. Another valuable rule is always to operate when infection is present.

Stones may be found lodged in any one or in several of five cardinal positions in the urinary tract: in the renal calices, in the renal pelvis, in the ureter, in the bladder, or in the urethra, each position demanding special separate consideration.

OPERATION FOR STONE IN THE KIDNEY.

The surgeon proceeds to operate with all the data before him gained by the urinary analysis, showing the presence or absence of pus and blood, the scratch marks from ureteral catheterization, and the X-ray finding. It is best to have an X-ray plate or print in the operating room for consultation. Sometimes

there is a bunch of stones in the pelvis and adjacent parts of the kidney near its lower pole, and a single isolated stone in the upper part of the kidney. Unless the X-ray plate is carefully consulted the upper stone is apt to escape the surgeon.

It is of the utmost importance to know whether there are stones on the other side. If a stone on one side, where the disease is bilateral, causes a stoppage in the escape of urine or pus, that side ought to be relieved first; if one side is quiescent and the other is badly infected we would advise operating on the worst side first. It will be proper to relieve both kidneys or both ureters of their burden when neither operation is very aggressive.

The incision to expose a stone kidney is best made posteriorly in an oblique direction from the angle between the quadratus lumborum and the last rib (the superior lumbar triangle) downward and outward about four inches in length (Figs. 173, 174, 175, 176). The latissimus dorsi muscle is exposed under the skin and lifted up or divided, so as to expose the superior lumbar triangle, which is opened by thrusting in a pointed forceps. The retroperitoneal fat pops out of the little opening made, and this is enlarged with a blunt instrument; then the finger is inserted and the opening pulled widely apart without using any cutting instruments. The kidney can be best exposed in this way when it is not much above the normal size. If the kidney is a large one, more room is needed than can be gained by blunt force; the incision can then be enlarged in a direction downward and outward, first parting the fibers of the external oblique muscle in its course, and then dividing the fibers of the internal oblique and the transversalis (Figs. 183-187). The incision can thus be readily made twice the size of the first opening. If the kidney is not enlarged, the fatty capsule is readily opened by thrusting the finger through the fat in a direction backward toward the vertebral column (Fig. 178), when the finger enters and readily hooks up the posterior plane of Küster's capsule, within which lies the kidney, enveloped in the perirenal fat. As soon as this is widely opened the hand is introduced and the kidney palpated. Often the hard stone is felt at once in the pelvis of the kidney.

Pyelotomy.—Whenever it can be done with safety, the stone in the pelvis of the kidney ought to be removed through the pelvis (pyelotomy) and not through the kidney tissue. A pyelotomy under favorable conditions is a simple, safe operation involving no hemorrhage, not even one drop, and absolutely free from any mutilation, while every transrenal operation is more or less mutilating, and even in skillful hands sometimes associated with great hemorrhage. There is always, too, the risk, following the renal operation, of hemorrhages into the pelvis of the kidney and down into the bladder. All these dangers are

avoided by pyelotomy, which is, therefore, the operation of election when conditions favor it.

A pyelotomy should be done when the kidney is movable and can be brought down within easy reach, and when its pelvis is easily accessible. Pyelotomy is contraindicated when the kidney is more or less fixed by inflammatory tissue and, above all, when its pelvis is so encased in hardened fat that it can not be

FIG. 346.—LARGE STONE IN LEFT KIDNEY SUCCESSFULLY REMOVED BY PYELOTOMY. In addition to this large stone in the pelvis of the left kidney, there were stones and pyonephrosis of the right kidney. (Mr. E. J., Ch. H. and I., Sept., 1909. Age 36.)

distinctly recognized and differentiated from the adjacent structures. Under such circumstances to attempt a pyelotomy is to risk tearing the rigid pelvis to pieces and leaving a permanent fistula behind. A pyelotomy is not to be done in a pelvis concealed within the kidney substance; it is also better not to do it when there are multiple branched calculi. Infected cases ought to be opened and drained through the dorsum of the kidney.

If the kidney is movable, after a little effort, by freeing it with the fingers at its upper pole, grasping the perirenal fat with successive pairs of forceps, so as to pull upon it simultaneously with four or five pairs, it can often be slipped out of the incision onto the surface without any trouble. The stone is then carefully located by palpation; the pelvis of the kidney is next exposed by removing some of the loose fat covering it, and the calculus is made to

appear at the most convenient point. This is usually in the lower angle of the pelvis on a line with or below the insertion of the ureter, where a small or moderately sized stone can be forced up under the protecting shelf of renal tissue bordering the hilum.



adherent to calculi

FIG. 347.—HYDRONEPHROTIC RIGHT KIDNEY DUE TO OBSTRUCTION OF THE UPPER URETER BY STONES. In sketch a, the appearance of patient before operation is shown, with the location of the swelling due to a big hydronephrosis. In b, is shown exposure and incision of renal pelvis and appearance of the upper part of the ureter, where its contour is altered by calculi in its lumen. In c, is shown removal of adherent stones from the ureter through a longitudinal incision directly over them. Duration of symptoms, consisting of intermittent tumor, pain in side and headache, 8 years. Symptoms in form of attacks lasting a few days and reappearing every two or three months. Urine normal, both microscopically and chemically. Most of renal function carried on by opposite kidney. The operation shown resulted in permanent relief. (Miss M. L. K., Gyn. No. 6598; age 37, Dec. 24, 1898.)

With the kidney drawn down and out, the vessels angle upward for the most part and leave the pelvis bare of vessels, exposing a wide area convenient for the extraction of the stone.

Sometimes the renal pelvis is the reverse of the usual type, lying in front of and not behind the kidney (see Chapter XIV). In this, too, the deep notch at the lower angle of the pelvis, which marks the limits of the zones of arterial distribution, is in front. In such cases it is easier and safer to open the pelvis in front. Very large stones can be removed through a pyelotomy incision when the pelvis is extrarenal (Fig. 346). With a hydronephrosis it can be quite

FIG. 348.—PYELOTOMY FOR STONE IN THE PELVIS OF KIDNEY. Note how the pelvis is brought into view by pressure from the finger. Note also the position, length and direction of incision. Be careful not to rub away, injure or displace the overlying peripelvic fascia which is invaluable in closing the wound.

simply managed, as shown in Figure 347. Pyelotomy is impossible with stones in the calices, as well shown in Figure 212.

The pelvis may be incised in a direction extending from the renal margin toward the ureter, if the exposure is a good one, making the opening just large enough to remove the stone by its smallest diameter with a scoop or delicate fenestrated stone forceps without tearing the tissues of the pelvis.

If the fat sticks to the pelvis and there is danger of tearing it, or if there is danger of cutting a vessel which lies hidden in the hard fat, we have found it a good plan to push the calculus forward from behind so as to make it prom-

inent (Fig. 348), and then to take a small, pointed pair of artery forceps and push it through the tissue onto the stone, opening the pelvis in this way. Then separating the blades carefully and watching to see that the opening spreads slowly in one direction, instead of making an irregular rent, we enlarge it until the stone slips out or can be withdrawn. When the pelvis is opened in this way, slowly and with care, there is no risk of rupturing a large vessel. Examine the stone at once for broken branches or facets showing the presence of other stones

FIG. 349.—SUTURING OF PYELOTOMY INCISION AFTER REMOVAL OF STONE. This should be done, when possible, in two layers, as shown; the first layer is the pelvis proper and the second the tough, strong fibrous coat overlying the pelvis, the so-called renal fascia. The suture material should be fine catgut. If one of these sutures has to be omitted I would rather leave out the first one passed directly through the tissues of the pelvis and rely on the fascial suture.

in the calices. Too much emphasis cannot be put on this examination, without which stones are sure to be left behind. A reconstruction of a large fragmented stone is shown in Figure 354. Fragmentation almost invariably occurs with the large coral stones. By noting the position of the stone in the pelvis one can then tell where to look for any fragments or finger-like stones up in a calyx.

After taking out the stone the little finger or a uterine sound may be inserted and the whole pelvis and the calices palpated.

If a perfectly satisfactory X-ray picture has been made, locating a single stone in the pelvis, one may then avoid the uncertainty and sometimes injurious effort of exploring the renal calices through the opening.

The incision is then sewed up with fine chromicized or cumol catgut, in

figure-of-eight or mattress sutures, catching the fibrous tissues enveloping the pelvis carefully, without appearing on the mucous surface (W. J. Mayo, H. A. Kelly). In this way the incision is snugly closed with from 3 to 6 sutures (Fig. 349). A short clean cut may be safely left to nature to close: indeed

FIG. 350.—STONES FILLING THE LOWER CALYX OF KIDNEY. Note the dilated pelvis and calices due to stricturing of ureteral pelvic junction. This was not due to kink or twist of the ureter, but more likely to an inflammatory condition induced by the passage of stones. The pelvis of the kidney is thickened and the parenchyma greatly altered, indicating serious past trouble. (J. H. H., Autopsy No. 3295.)

not a drop of urine may escape after the operation even when the wound is left without any attempt at closure by suture.

The kidney is then returned to the abdomen and the wound closed, a small gauze drain, wrapped in protective, being inserted, leading back to the position of the kidney.

Nephrolithotomy.—Where the stones extend out into the calices, branching in various directions, or where there is much surrounding inflammatory trouble, fixing the pelvis of the kidney, or where there is a marked infection, nephro-

.

.

b

FIG. 351.—REMOVAL OF LARGE CORAL STONE FROM RENAL PELVIS AND CALICES THROUGH NEPHROTOMY INCISION. Such a stone is practically never removed in one piece. The central piece, nearly always broken away from upper piece, may be removed first. The lower pole may be broken, or if very hard, removed with middle portion. Such stones are often quite adherent to the walls of the pelvis and must be freed by gentle pulling associated with rotary movements. The stones in the polar calices are removed as shown in upper diagram. Such a stone should always be reconstructed, as shown in the right-hand figure, in order to demonstrate that the entire stone has been removed. The fenestrated forceps shown are most serviceable.

lithotomy, or the removal of the stones from the calices and pelvis through the dorsum of the kidney, is the most satisfactory operation. Stones such as those shown in Figures 303, 304, 323, 350 and 359 can only be removed by a wide nephrotomy incision. If it is possible to free the kidney carefully on all sides

and to slip it out of the incision onto the surface of the body, this is the simplest and most satisfactory way of handling it. As a rule, however, the kidney is so fixed by the surrounding perinephral inflammation that the stones must be removed *in situ* or not at all. In this case, after making an incision sufficiently long to expose the kidney perfectly, the nearest stone in the cortex is located by palpation, or by gently using a straight needle. The opening down onto the stone or stones is made directly inward, parallel to the long axis of the kidney, by means of a blunt, flat needle armed with a single silver wire, according to the method devised by M. Broedel and worked out experimentally by E. K. Cullen and H. F. Doerge (Figures 218, 219, 220, and 221). By the use of the blunt, curved needle and the silver wire the kidney can

FIG. 352.—DEEPLY SCRATCHED WAX - TIPPED CATHETER. From impact against stones in pelvis of kidney. (Mrs. M. H., Gyn. No. 8639, April, 1901.) See four succeeding figures.

be separated into its two vascular leaflets from cortex to pelvis without any noticeable hemorrhage and without any injury to any important vessels necessarily resulting in an infarct and the destruction of the zone of renal tissue supplied by the injured vessel. A No. 3 silver wire is used, being introduced through the substance of the kidney deep down toward the trunks of the vessels. The capsule of the kidney is caught at the points where the wire emerges. The kidney itself is supported by a firm counter-traction as the wire is brought slowly to the surface with a see-saw movement

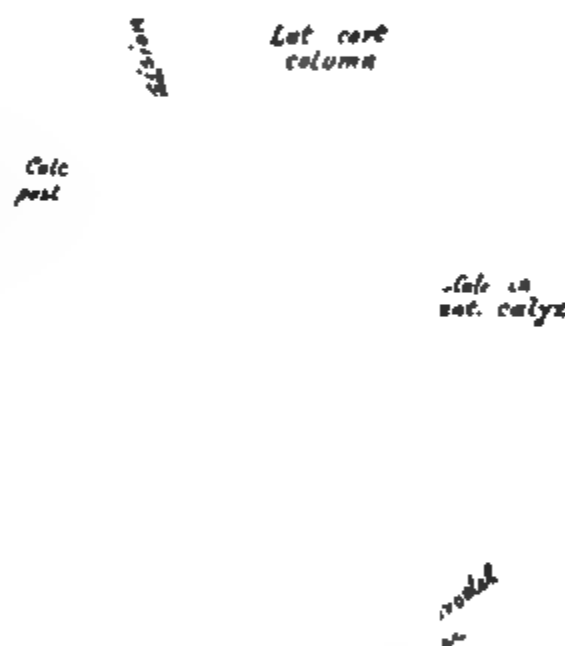


FIG. 353.—LENGTH AND POSITION OF NEPHROTOMY INCISION IN CASE ILLUSTRATED IN THREE SUCCEEDING FIGURES. Lower figure shows transverse section of kidney. Note position of incision in non-vascular plane. Note thinning of parenchyma, which renders incision easy and comparatively bloodless. Note likewise how in such a case fragments of stones in remote pockets may be overlooked. (Mrs. M. H.)

like that used in manipulating a wire saw. When the needle encounters one of the renal vessels in the course of its introduction the resistance is recognized at once and, upon moving the needle slightly to one side or the other, the vessel is avoided and so escapes injury.

After opening the kidney, which should be delivered into the abdominal incision, the assistant grasps the pedicle, or it is compressed by packing gauze down against it, and then the stone is removed by a conveniently shaped forceps, as shown in Figure 351.

A complete record, showing the wax-tip catheter scratched, the incision to expose the stone, the fragmented stone, and the appear-

ance of the kidney removed one year later, owing to persistent infection, is shown in Figures 352, 353, 354, 355, and 356. The case well illustrates the diffi-

culty frequently encountered in alleviating infected kidneys. When most of the parenchyma is destroyed it is far better to do a nephrectomy. In this case we hoped for healing, as the secreting part of kidney was well preserved.

After a stone filling a calyx has been removed it is, as a rule, possible to feel the pelvis of the kidney and other calices to determine whether others are present or not. Where there are large branching masses it is well to continue the splitting from the lower pole of the kidney upward, opening the pelvis widely, so that the whole can be taken out as far as possible in one mass. An

FIG. 355.—KIDNEY REMOVED ONE YEAR AFTER NEPHRECTOMY, FOR STONE. Note scar. The same case as illustrated in the three preceding and the following drawing. $\frac{3}{4}$ natural size. (Mrs. M. H.)

opening made in this way ought to follow Broedel's lines (see Chapter XVI), which avoid the vessels. In Figures 357, 358, and 359 are shown the entire



FIG. 354.—FRAGMENTS OF STONES REMOVED IN THE CASE SHOWN IN PRECEDING TWO FIGURES. The lines indicate probable reconstruction of stones. $\frac{3}{4}$ natural size. (Mrs. M. H.)

record of a singular and interesting case: 1st, the scratched wax tip; 2nd, the incision into kidney; 3rd, the stones. When the lower pole of the kidney has been emptied of its stones one can sometimes carry the finger into the pelvis

FIG. 356.—KIDNEY SHOWN IN PRECEDING FIGURE LAID OPEN. Dilated pelvis and calices after a year of unobstructed drainage; thinning of cortex, abscess, small calculi and scarring. Symptoms, repeated attacks of colic lasting several hours and recurring from four to six times a year. Duration of symptoms, fifteen years. Pain and frequency of voiding. Stone demonstrated by wax-tipped catheter and by X-ray. Urinary infection and pus, opposite kidney normal. Nephrotomy, removal of stones, April, 1901; continued pain and pyuria led to nephrectomy March, 1902, followed by a prompt and permanent cure. (Mrs. M. H., Gyn. Nos. 8639 and 9442. Apr., 1901, March, 1902.)

and up into the upper pole and distinguish a separate set of stones there. Using the finger as a guide in this way the operator then makes a separate incision into the upper pole, in no way connected with the lower incision, and removes the stones above as well. After such an operation deliberate steps should be taken to make a careful search, using the finger or a curved metallic sound to enter each calyx and discover whether any stones have been left behind. The use of a strong stream of saline solution or warm boric acid is sometimes of value in removing the débris of the stones.

When the kidney is distended with pus or is hydronephrotic from the stone

in the pelvis blocking the ureteral orifice, it is easy to open the fluctuating, thinned-out cortex, and carry the finger at once into the pelvis, then, as the fluid rushes out, catch and deliver the stone.

If a single stone is precisely located by the X-ray, either in the upper or lower pole of the kidney or in its median zone, it can sometimes be sneaked out through the dorsum of the kidney by the simplest operation possible. For example, if the stone is in the lower pole, this is exposed and tilted up, and the precise location of the stone is determined by using

a fine needle fixed in a cork. The capsule proper is then incised and a sharp instrument, such as a pair of fine scissors, is pushed in, until it touches the stone, which is supported by the fingers grasping the kidney. The wound is then enlarged a little by opening the scissors, a small stone forceps is introduced, and the stone is extracted. One fine suture will, as a rule, close the incision. In like manner the upper pole can be tilted over and operated upon.

Closure of the Wound.

When there is no hemorrhage, the wound is best closed by using a straight needle and suturing the capsule with a continuous suture passing to and fro until the wound is completely closed. Fine silk or cumol-formalin catgut may be used for this. If marked hemorrhage is noted at any point on the cut surface it is best to control this while the vessel can be isolated, by drawing it out with a pointed artery forceps and

FIG. 358.—NEPHROTOMY INCISION IN THE NON-VASCULAR PLANE USED IN THE CASE SHOWN IN PRECEDING AND FOLLOWING FIGURES. The dotted line shows upward extension of this incision. (Mrs. C. J.)

ligating with fine catgut. Where the bleeding can not be controlled in this way it can be controlled by taking a long needle with a blunt point, transfixing the kidney from side to side, and then bringing the suture back again so as to

FIG. 357.—WAX-TIPPED CATHETER, SHOWING GOUGES FROM LARGE STONE IN PELVIS OF LEFT KIDNEY. The catheter from right kidney also scratched. See succeeding figure. (Mrs. C. J., Gyn. No. 12880, April 30, 1906.)

embrace the bleeding area (Figs. 225 and 226). When the suture is tied the bleeding is stopped effectually. The function of this portion of the kidney is necessarily suspended until this suture is absorbed. In passing the needle one

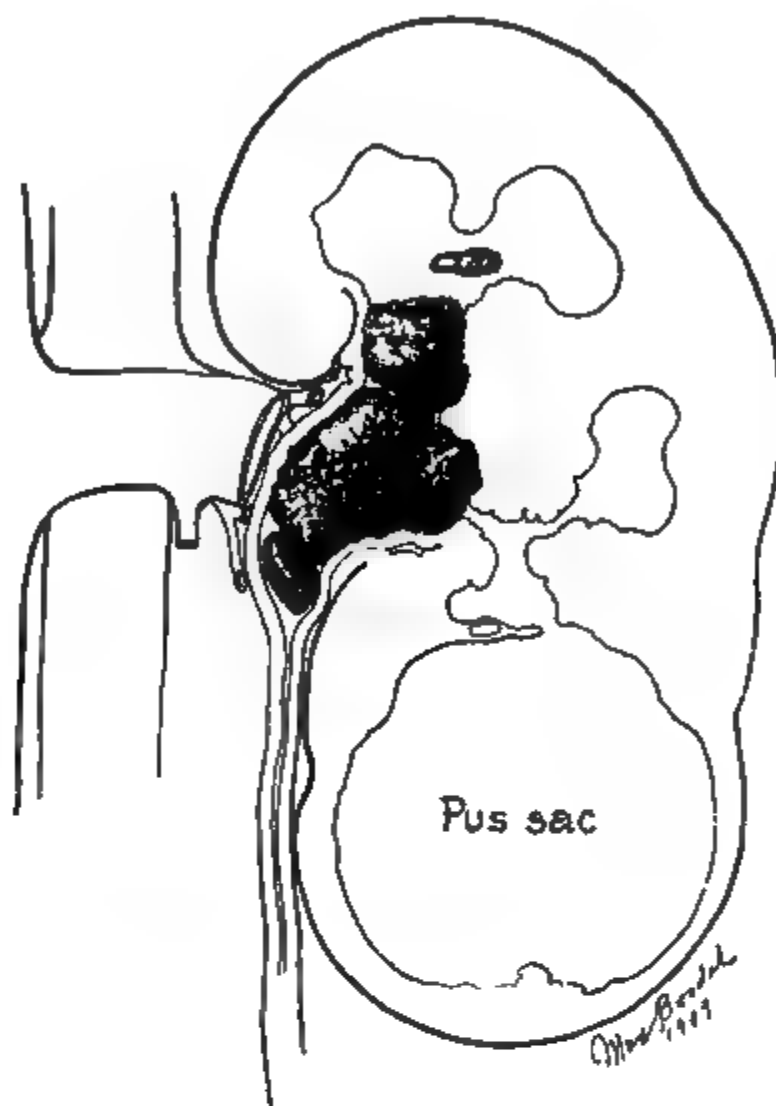


FIG. 359.—LARGE CORAL STONE IN RIGHT KIDNEY, FILLING PELVIS AND CALICES. Irregular stones in pelvis of left kidney and dilatation of lower calices into a pus cell, with partial destruction of that part of kidney. Repeated attacks of renal colic in both kidneys, and spontaneous passages of fragments of stones. Both kidneys infected with colon bacillus. Both X-ray and wax-tip diagnosis of stone positive. Bilateral nephrotomy, removal of stones. Patient continues to live without colic, but with persistent infection on both sides. (Mrs. C. J., Gyn. No. 12880, age 30; April 28, 1906.)

must avoid the vascular zones of the kidney evidenced by the white lines between the lobules.

It is extremely necessary to secure complete hemostasis, as severe hemorrhage can, and often does occur. Even when the hemorrhage is not dangerous, so far as exsanguination is concerned, it may lead to plugging of the ureter with clots, such as those shown in Figure 360.

In infected cases a mushroom catheter should be inserted into the kidney and badly infected kidneys are best left open without suture.

FIG. 360.—CASE OF STONES IN KIDNEY AND URETER, BILATERAL RENAL TUBERCULOSIS AND TUBERCULOSIS OF THE BLADDER. A nephrotomy and partial nephrectomy was attempted on the left kidney. Marked post-operative hemorrhage occurred with the passage of the clots shown on the right, making casts of the ureter. Note number and distribution of stones. Patient recovered from this operation, but died from uremia on March 3, 1906. (Miss M. W., operated on at the Ch. H. and Inf., Oct. 13, 1905.)

Nephrectomy.—If the examinations previous to the operation have made it clear that the opposite kidney is sound and doing all the work of excretion, while the affected side is badly infected, secreting little or no urea (Fig. 361, also Figs. 301 and 302), showing that the stone kidney has been converted into a pus kidney, then a nephrectomy is the best course. In this case the kidney is carefully freed on all sides, special pains being taken on the right side not to injure an adherent duodenum or colon. As a rule, it will be necessary to

Sinus

diminish the size of the kidney before attempting to bring it out of the incision. It is impossible to avoid infecting the wound, and with good drainage there need be no ill result from doing this. We would, therefore, recommend boldly opening the dorsum of the kidney, emptying it of its pus, breaking up all loculi, and removing the stones as far as they can be conveniently reached. The collapsed kidney is then further freed from its attachments, particularly around the hilum, the ureter is exposed and ligated, and its lower end sterilized with carbolic acid and dropped. Then drawing

FIG. 361.—SHRIVELED KIDNEY SURROUNDED BY FAT WHICH ON PALPATION SIMULATED A NORMAL KIDNEY. The ureter is blocked by a small stone. A sinus ran from an old nephrotomy incision, down to the pelvis of the kidney. (Miss M. D., Dec. 16, 1901.)

the kidney downward, if it will come readily, so as to bring all vessels within reach at the same time, the pedicle is tied off step by step with strong catgut by means of an aneurysm needle. Sometimes one can remove the kidney best by proceeding in the opposite direction, from the upper pole downward step by step, tying one vessel at a time, tying and cutting until the last is severed, when the organ is lifted out (Figs. 293, 294, 295, and 296).

Sometimes it is easier to attack the vessels in a direction from below upward, taking them one by one, passing the ligature with an aneurysm or other blunt needle. It is our practice to overlap these ligatures as they are passed in order to make the assurance against hemorrhage doubly certain. If the vessels

incline to pull away as the hilum is severed, creating a risk of hemorrhage from a rupture of the last strands in the hilum, it will be a wise plan to clamp the remaining vessels at a point well away from the hilum and then to tie them in a leisurely manner.

Nephrolithotomy Followed by Nephrectomy (Intracapsular Enucleation).—If the opposite kidney is affected, or if the surgeon is doubtful whether or not the affected kidney ought to be saved, or if the patient is in bad shape, the first step may be that of doing a nephrotomy to relieve urgent symptoms, to remove the stones, and to give free drainage to the pus. Sometimes a kidney treated in this way will rejuvenate and do good work. Often, however, the result will be a disappointment. The patient will suffer from a semi-purulent fistula in the side, necessitating the constant wearing of gauze pads, and the operator will regret his attempted conservatism. Not infrequently the patient is so desperately ill at the first operation that it is impossible to do anything more than the briefest operation, which is to open and drain the kidney. Under these circumstances a nephrectomy following nephrotomy gives complete relief. These nephrectomies are, for the most part, dreaded by our surgeons. This is because of the dangerous effort commonly made to shell the inflamed kidney with its adherent capsule and perirenal fat out of the often densely adherent surrounding tissues. While such an operation can, as a rule, be brought to a successful conclusion, the risks are great. There is danger of opening the peritoneum, of opening the duodenum, and of rupturing the renal vessels. The ideal operation in such a case is an intracapsular nephrectomy. This is done in the following manner: The fistula is taken as a guide and a grooved director inserted well into the kidney. The old incision is then opened up in its length and down in its depth into the kidney substance, or better still the fistulous tract and much of the scar tissue is excised. The opening of the kidney is then made large enough to introduce one or two fingers, which are carried well up into the abscess cavity within the kidney itself; the fingers are then hooked and forced through the kidney substance in the direction of the capsule, rupturing the cortex. The capsule is so dense that the fingers will not penetrate it. A plane of cleavage having thus been established between the softer renal cortex and the dense capsule, the fingers are slipped around on all sides above and below, shelling the kidney out of its capsule, in the course of two or three minutes, and leaving it attached only at its base by its vessels. The operator now proceeds with greater care and caution, freeing the kidney tissue proper until it is only held by the few vessels which enter its hilum. As he pulls the base of the kidney toward himself the vessels are, to some extent, skeletonized, and can be seen and tied off one by one, or grasped with a strong clamp, while the

kidney substance is cut away, after which the exposed vessels are readily tied and the clamps removed. In this way a dangerous operation is converted into one which is perfectly safe. This procedure is illustrated in Figures 293, 294, 295 and 296.

A liberal loose drain is inserted into the cavity of the thickened capsula propria and the outside opening left large enough to drain freely and rapidly.

OPERATION FOR URETERAL STONE.

Stone in the Upper Ureter.—A stone is apt to lodge in the upper ureter, just below the pelvis of the kidney. It is readily felt in this position after an

incision is made to expose the kidney in the manner described. Indeed, on palpation through the wound, it is often not possible to say whether the stone is in the ureter or the lower part of the renal pelvis. The external wound should be large enough to afford free access to the ureter. This is carefully bared by pushing the peritoneum and fat away from its anterior surface, but taking care not to detach it entirely from its bed. In incising the ureter it is important not to dissect off or remove the delicate but strong fascial envelope, as this can be used to the utmost advantage in closing up the wound. The strong investing sheet affords a firm hold to the thread, and is of itself sufficient to bind the edges of the ureters closely together during the process of healing. The hard area which marks the stone is freed from the surrounding fat, the ureter being

FIG. 362.—EXTRACTION OF STONE IN THE URETER BY MEANS OF STONE FORCEPS, INTRODUCED THROUGH INCISION IN MANNER SHOWN. This method can be used when the low position of the stone makes direct incision onto it difficult. Alligator forceps can be used for a long reach from pelvic brim to floor or even anterior pelvis.

exposed, when an incision is made over the lower pole of the stone, usually not more than one or one and a half

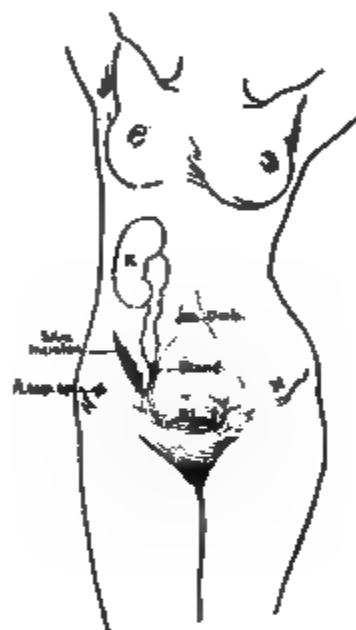


FIG. 363.—DIAGRAM OF THE RIGHT KIDNEY AND URETER; STONE IN URETER AT PELVIC BRIM; INCISION MADE TO REMOVE STONE. Symptoms, repeated attacks of pain, beginning in right loin and radiating to bladder; duration five years. Attacks originally short and coming infrequently have steadily increased in severity and recur every few weeks.

centimeters in length in the long axis of the ureter, care being taken to avoid ureteral vessels. The stone thus exposed is grasped with suitable stone forceps and withdrawn (Fig. 362). The linear wound in the ureter is then closed with fine silk sutures and a delicate, curved French needle with a split eye. It is best to slip in a little cigarette drain of gauze surrounded by protective near the seat of the wound. This can be removed after three or four days if there is no leakage. The incision is closed down to the drain, layer by layer. In one of our cases we found a curious little stone bent on itself in the form of the letter U, pinching tightly a part of the ureteral tissue in the angle, so that the stone was not free in the ureter, but, as it were, grown to it. It required some little pulling to deliver the rough stone from its bed.

Stone in Ureter near Pelvic Brim.

—When the stone is lodged near the brim of the pelvis, somewhere about the middle portion of the ureter, the incision should be made either about the position of McBurney's point on the right or left side, or, preferably, we think, in the semilunar line (Fig. 363). In a thin patient a small incision, about six centimeters long, may suffice; in others it should be made eight or ten centimeters in length. The incision is carried down to the peritoneum, which is then carefully lifted up and pushed over toward the median line. The intestines can be felt and sometimes seen through the peritoneum. When the iliac vessels are reached the operator knows that the ureter is close by. As he continues to lift the peritoneum the ureter is lifted up with it, remaining attached to the peritoneum rather than to the posterior abdominal wall like the vessels. If the stone has been previously located a little careful palpation will soon reveal its position. The ureter is then bared below, over, and above the stone for a little distance. It is sometimes a good plan to pass sutures beforehand from side to side, and then, pulling the sutures apart, make a longitudinal

FIG. 364.—EXTRA-PERITONEAL EXPOSURE OF PORTION OF URETER CONTAINING STONE, SHOWN IN LAST FIGURE. Note convenient incision of ureter between two guy sutures. Take great care to preserve the peri-ureteral fibrous investing tissue which surrounds it like a loose strong web and if uninjured except by incision is most valuable asset in the closure. This is not shown here.

FIG. 365.—INCISION AND REMOVAL OF STONE BELOW THE STRICTURE. The actual procedure carried out in the case of the stone pictured. When the stone can be clearly recognized by touch, then the smallest possible incision should be made, directly down onto its lower pole. A stricture so sharply defined may also be dilated bluntly. Remember that after closing the ureter with a direct suture, the overlying fascia must then be approximated.

appearing on its mucous surface (Fig. 365). It does not matter much just what form of suture is used, provided the sides are brought together with accuracy. We prefer in all these cases a figure of eight. The wound is closed completely with the exception of a cigarette drain, which is carried down to the ureter.

Stone at the Pelvic Floor.—When the stone is down on the floor of the pelvis, or lodged in the last five or six centimeters of the ureter, the operation may be either easy or difficult. Knowing the location of the stone the operator makes his incision over the semilunar

incision for the removal of the stone (Fig. 364). We prefer ourselves, however, to grasp the stone in such a way as to close the ureter above and below it, and then to incise it over whichever pole is most convenient and squeeze it gently out of the ureter, delivering it by its small diameter. As soon as the stone is removed, fine silk sutures are passed, engaging the walls of the ureter with its surrounding fibrous investment, without

FIG. 366.—CALCULUS IN LOWER URETER, CAUSING HYDROURETER. The stone in this case was gradually milked up from near the bladder to the pelvic brim, where incision was made into the ureter and the stone removed. (From H. Young, Ch. H. and Inf., Oct. 6, 1901.)

line, as was just described, a little lower down over the side of the brim of the pelvis. The peritoneum is then separated in its depth, exposing first the iliac

vessels and then the pelvic walls, until the internal iliac vessels and the ureter clinging to the peritoneum are exposed. If the ureter is manifestly dilated, owing to the obstruction of the stone, it is often possible to enlarge the skin incision in an upward direction until the ureter is exposed nearer the pelvic brim, where it is closer to the surface, and where it is conveniently reached. Then lifting it up carefully, so as not to bruise it or its vessels, a longitudinal incision is made into its lumen, when a pair of forceps carried down the ureter grasps the stone and draws it up and out. This is the simplest way to remove a stone low down on the pelvic floor. The ureteral incision is then closed, and the abdominal wound is closed, leaving a little drain *in situ*. The next simplest plan for removal of such a stone is this: After exposing the ureter the operator continues to make a blunt dissection with his fingers, freeing the anterior portion of the ureter and pushing into the fat until he feels the stone in the ureter. The dissection is then continued until the area around the stone is liberated, and until the ureter is also set free in front of the stone, care being taken not to detach it, however, from its lateral attachments to the peritoneum or the bladder. After a considerable portion of the ureter has been set free in this way it is gently caught between the thumb and the forefinger below the stone, and an effort is made to push the stone up the ureter. If the ureter has been dilated and the stone is free and not too large, it is often possible to work the stone upward to a point at or near the pelvic brim, where it can be removed with ease. This was accomplished by Dr. Young in the case pictured in Figure 366. This is the plan known by Israel's name. We found it possible to do this, and in one case where a spiculate stone was lodged in the left ureter in a man, in a position very difficult of access on account of the depth of the pelvis and the amount of fat present, we were able to work the stone about five or six centimeters backward from the position where it had lodged, and there to incise the ureter and remove it. The operation was awkward because the wound was deep and the stone was still on the pelvic floor. It was, however, much easier than the almost impossible operation of removing it *in situ*. We closed this wound by sutures engaging only the ureteral fascia, which is more marked on the floor of the pelvis; fine silk sutures were used, and the patient recovered without the slightest leakage of urine at any time.

Stone in the Vesical Portion of the Ureter.—When the stone is lodged in the anterior or vesical end of the ureter, and on account of its size or attach-



FIG. 367.—URETERAL CALCULUS LODGED IN VESICAL END OF URETER. The small stone to the right was passed spontaneously and found in the urine. Natural size.

ment to the ureteral tissues cannot be worked back, it is sometimes exceedingly difficult to remove it. In such a case one of a variety of procedures is possible.

FIG. 368.—COMBINED ABDOMINAL AND VAGINAL INCISIONS TO REMOVE STONE SHOWN IN FIG. 367. The abdominal incision enabled the operator to grasp the stone in the ureter and push it against the vaginal wall, through which it was removed by incision through both vaginal and ureteral walls, as shown in picture. This was a large stone embedded in adhesions.

In a woman the ureter passes through a little channel under the uterine artery and veins at the base of the broad ligament, lateral to the cervix. The finger can be worked through this channel without injury to the ureter, and with the

finger hooked up, the uterine vessels are brought within reach and control. If a double ligature is now passed through this opening on the finger and tied on both sides, and the vessels are divided between the ligatures, the broad ligament portion of the ureter is readily exposed (Fig. 196). Following the ureter thus plainly seen and tracing it downward, its anterior portion can be exposed, a stone located, the ureter incised, and the stone removed. An assistant, putting his finger in the vagina and pushing upward, can sometimes materially assist in bringing this portion of the ureter within easy reach. In one of our patients, where we had secured the most distinct scratch marks, we found a little, sharp, spiculate stone fixed

firmly into the wall of the ureter and embedded in it (Fig. 367), just a short distance from the vesical end of the ureter. We could not feel it or find it through the vagina, as it was so small. We incised the ureter, removed the stone and closed the wound, when the patient

FIG. 369.—STONES REMOVED FROM URETER IN CASE SHOWN IN PRECEDING FIGURE, ALSO FIG. 325. The appearance is that of a pure oxalate stone. The sharp knife edges are well calculated to abrade the mucosa; where the attrition is greatest they are worn rounded. (Mrs. E. J., Gyn. No. 7762, Apr. 28, 1910.)

recovered, though not without leakage and a stormy convalescence. In one case, where there was a large stone embedded in a mass of adhesions back of the uterine vessels (Fig. 325), we opened the abdomen, located the stone, and pushed it in the direction of the vaginal vault, not displacing it in the ureter, but displacing the ureter with the stone until the stone was made accessible, when we incised the vaginal vault and incised the ureter extraperitoneally over the lower pole of the stone, which we removed without injuring the peritoneum (Fig. 368). The actual appearance of this stone and of scratch marks made by it are shown in Figures 369 and 370. This patient recovered from the operation and

FIG. 370.—GOUGED WAX-TIPPED CATHETER DUE TO PASSAGE OVER STONE IN RIGHT URETER. (Mrs. E. J., Gyn. No. 7762, Apr. 28, 1910.)

went home, but later suffered from intestinal obstruction, owing to adhesions about the original site of the stone at the pelvic floor, and died. When the stone

can be felt through the vagina an incision can be made through the anterior lateral vaginal wall, exposing the ureter. Then, cutting in the longitudinal axis of the ureter over the end of the stone, it is readily pulled out and the incision closed with fine silk sutures, leaving the vaginal wound to close with drainage. One must be careful in these cases that the stone does not slip up and away in the midst of the operation. In such an event it would be better to make the superior incision and draw the stone out of the ureter near the pelvic brim.

Transvesical Removal of Ureteral Stones.—When the stone is lodged in the vesical end of the ureter it can be removed in one of several ways. This condition is shown in Figure 319. The easiest cases are those in which a stone is seen projecting from the ureteral orifice.

Dislodging a Stone Wedged in Ureteral Orifice.—Here it is safe to grasp the end of the stone with a pair of alligator forceps through an open cystoscope, to extract it from the ureter, and to remove it at once from the body. If only the point of the stone is seen and the rest will not follow readily, the orifice may be dilated with a pair of alligator forceps so as to facilitate the delivery. Bransford Lewis (*New York Med. J.*, 1912, xvi, 1002) reports several successful cases and describes the very in-

FIG. 371. — TRANSVESICAL REMOVAL OF STONES FROM VESICAL END OF URETER, THROUGH VESICOVAGINAL INCISION. Attacks of pain in the region of right kidney at irregular intervals for 3½ years. Cystoscopic examination showed a big swelling in the bladder at the site of the right ureteral orifice. Operation through cystoscope, though sometimes suitable, was not adapted to this case. A normal-sized and perfectly normal ureteral orifice was ultimately found after removal of stones. (Mrs. R. A., age 45, San. No. 1366, May 14, 1902.)

genious instruments he employs with his cystoscope.

Dilating the Ureter with Bougies.—Where the stone is felt behind the ureteral orifice, if it is not too large or too firmly fixed, one can sometimes succeed in dilating the orifice of the ureter with catheters or

bougies successively larger in size until one is introduced as large as 5 or 6 mm. in diameter. After thus dilating the orifice a little oil may be injected to lubricate the passage and facilitate the escape of the stone. One of us (Kelly) did this successfully in the case of Mrs. H., in January, 1900. She had been suffering from repeated attacks of colic in the left kidney extending down the ureter to its vesical orifice where the pain was centered. The left ureter at its vesical end was exquisitely tender, and one could feel a distinct firm enlargement half way between the internal ureteral orifice and the cervix uteri. The ureter and the surrounding parts were first cocainized by injecting a one per cent. solution of cocain through the vaginal wall into the tissues adjacent to the ureter. Then, with the patient in the knee-breast posture, and by the use of a No. 10 open speculum, the deeply reddened, everted left ureteral mucosa was found in marked contrast to the healthy right orifice. A wax-tipped catheter was introduced a short distance and showed scratch marks, proving the presence of a stone. After carrying the catheter further up the ureter, 16 c. c. of pent-up urine escaped, showing a low grade of hydronephrosis. The impact of the catheter also broke off a little piece of stone 1 mm. in diameter; this was examined chemically by Dr. Louis Hamburger, of Baltimore, and shown to be made of uric acid. A ureteral dilator was then pushed through the strictured vesical ureteral orifice until it was stretched to a lumen 3 mm. in diameter. Nineteen hours after this an oblong stone, 10 mm. in length and 3 mm. in diameter, escaped, with the immediate relief of all the symptoms.

Transvesical Opening of the Ureter.—Where a mass of ureteral stones or a large calculus is lodged well back of the vesical orifice and

FIG. 372.—VIEW OF BLADDER AND UTERUS IN THE KNEE-CHEST POSTURE, SHOWING OPENING IN TRIGONUM AS PICTURED IN LAST FIGURE. Note direction of ureters as they converge toward the trigonum. The calculi filled the lower end of the right ureter as shown in figure. (Mrs. R. A., San. No. 1366.)

yet near enough to the bladder to produce a bulging on the vesical mucosa, if it is not easily accessible through the antero-lateral vaginal wall, one can get at the calculi by putting the patient in the knee-breast posture, thus letting air into the vagina, introducing a catheter into the bladder and distending it with air (Fig. 371).

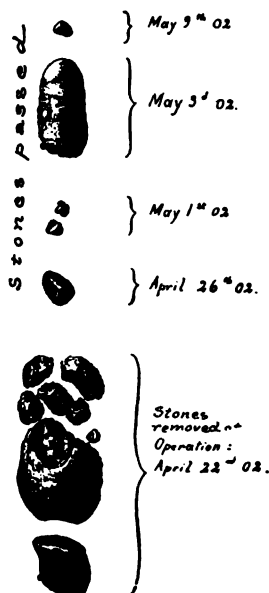


FIG. 373.—STONES REMOVED AT OPERATION AND PASSED SUBSEQUENT TO OPERATION, IN CASE ILLUSTRATED BY TWO PRECEDING FIGURES. The stones, as shown, are $\frac{1}{2}$ natural size. (Mrs. R. A., San No. 1366.)

The posterior vaginal wall is then lifted up by a broad Sims' speculum and retracted at the same time so as to give the operator a perfect view and easy access to the anterior vaginal wall. The cutting part of this operation may be done by the injection of cocain into the vaginal septum, obliterating all sensation. If, however, the patient is nervous it will be better to use general anesthesia. Then the vaginal wall is opened by thrusting a narrow-bladed scalpel, preferably one set onto the handle, at an angle of 45 degrees, through the vesico-vaginal septum in the median line about half-way between the internal urethral orifice and the cervix. As the knife penetrates the septum into the air-distended bladder it sometimes gives a sound similar to that of a sharp instrument being thrust through the parchment of a drum head. The wound is then enlarged in an antero-posterior direction until the opening is big enough to introduce the index finger. On introducing this finger, the exact location of the prominence made by the calculus is determined near the position of the urethral orifice. The finger determines also to what extent the incision may be safely made. There is, as a rule, no bleeding, as the vessels are emptied of their blood by their position. Any blood that escapes, runs down into the vertex of the air-distended bladder and so does not inconvenience the operator. With a narrow spatula the side of the

opening is retracted until the hard, bulging prominence is exposed to view (Fig. 372). This procedure was carried out in the case illustrated in Figures 371, 372, and 373. Incision is then made under the end of the stone nearest to the ureteral orifice and the stone extracted. A careful search must then be made for other stones, and it will be an easy matter at the same time to carry a wax-tipped bougie up into the kidney to see if there are any stones there. When the stone is lodged close to the ureteral orifice, it may be

a good plan to introduce a grooved director and to cut through the orifice up to the stone. Where the stone is extracted by cutting directly through the vesical mucosa we think the best plan is to allow the opening to remain as the future ureteral orifice. Often there will be no bleeding and the wound in the bladder may be left to take care of itself. If there is any hemorrhage at all it may be easily stopped by fine catgut sutures passed over the vesical and ureteral tissues at the bleeding points. The incision ought to be made far back into the bladder in order to avoid opening the loose cellular tissue and to escape infection. After the operation the bladder should be wiped out through the capacious opening in the vesicovaginal septum and the opening into the vagina closed by fine interrupted silkworm gut sutures placed a little less than 1 cm. apart, embracing all the tissues except the vesical mucosa. A mushroom catheter is then inserted through the urethra, and the bladder drained for six or seven days, being washed out every day with a warm boric solution through the catheter. In the male this operation should be done by a suprapubic route. If there is no cystitis, the bladder may be closed snugly at once, and the skin wound closed down to a small protective drain. Figure 373 shows the stones removed from the right ureter by this method, April 29, 1902, and on four different dates the remaining stones shown in the upper part of the figure escaped, showing the importance of leaving open the ureterovesical wound. The patient recovered and has since remained well.

AFTER - TREATMENT.

The after-treatment of patients who have had one of the various operations described for stone in the kidney or ureter, does not differ materially from that employed in other operations, particularly kidney operations, and has already been described in the preceding chapters.

It is a good plan always to give abundant water and urotropin. The chief complications are hemorrhage after nephrotomy, which may require immediate secondary removal of the kidney, suppression of urine, and uremia. One of the commonest complications in the uremic cases is post-operative insanity, a condition which is very alarming and frequently fatal. We recently observed such a case.

SUMMARY.

Our information as to the frequency of occurrence and the morbidity of stones in the kidney is manifestly insufficient. Under the more frequent employment of the exact radiographic method of diagnosis the disease is known

to be very much commoner than was formerly supposed. What percentage of the population, however, is affected by these stones is not known. It is well known that patients may go for years without great discomfort. The outlook is much better for patients where only one kidney is affected, and for those where the complication of infection has not supervened. It is certain that the mortality is very high in cases of bilateral stone with bilateral infection.

The occurrence of anuria is one of the absolute indications for immediate operation, and the cases operated upon early have a much better outlook than those postponed. The operation in such cases should be nephrotomy invariably. A comparison of the results of operation in antiseptic cases and those with sepsis justifies the conclusion that every stone which will not readily pass demands operation. Compare, for example, the personal experience of Rafin and Arcelin (*"Calculs du reins et de l'uretère,"* Paris, 1911), who in 19 aseptic cases had one death from operation, while in 29 septic cases there were 5 deaths. Interestingly enough, all of these deaths were from nephrectomies. There are no satisfactory statistics at hand to show the relative danger of nephrotomy and nephrectomy. In large pyonephroses in cases with bilateral involvement nephrotomy is the only operation allowable.

With multiple abscess of the kidney, the other organ being perfectly normal, nephrectomy is perhaps safer and better.

The investigations of Sondille (*"Thèse de Paris,"* 1907) have apparently shown, by functional studies of the opposite kidney, that it is usually more or less affected in stone cases, and this perhaps accounts for the frequency of anuria following operative interference. We have never lost a patient operated on for unilateral non-septic stone in the kidney in 27 cases; on the other hand, our death-rate in septic cases has been 11 cases out of 69 operated upon. One was in a solitary kidney; 6 were in bilateral kidney infection, and 4 in unilateral infection with an apparently normal kidney on the other side.

Legueu (*"Traité chirurgical d'urologie,"* 1910) notes in 420 non-septic cases collected from the literature a death rate of a little more than 9 per cent. This high rate is doubtless due to the fact that many of the deaths occurred where both kidneys were involved. In 473 infected cases there was a death rate of 23 per cent.

In non-infected cases there is very little difference in the death rates between pyelotomy and nephrotomy, although the convalescence is much easier after the first operation. In septic cases pyelotomy should never be done.

CHAPTER XXI.

BLADDER AND URETHRAL STONES.

BLADDER STONES.

Observations and good descriptions of stones in the urinary bladder are found in the earliest medical literature. The surgical removal of stones from the bladder by perineal section, from its introduction by Frère Jacques in the Middle Ages, remained the greatest surgical operation widely practiced up to the modern anesthetic, antiseptic period. Many surgeons still living recall this period's birth. The treatment of vesical calculi has benefited less by modern diagnostic methods than that of renal and ureteral stones, nevertheless it has been enormously developed.

Occurrence.—While vesical stone is met with at every period of life, and in both sexes, it is commonest in old men and in young children. It is, indeed, a rather rare affection in women, being usually met with solely in diverticulate bladders or in cases with large cystoceles and incomplete emptying of the urine at each voiding. Although we see comparatively few children, we have had more cases in little girls than in adults. The immunity of women is explained by the short, large-calibered urethras which allow any stone that comes down a ureter to pass to the outside with ease, and by the rarity of residual urines. The greater frequency in children can be appreciated by the statement of Bokay quoted by Leguen (*"Traité chirurgical d'urologie,"* 1910, 759), who found in a review of 1,621 stone cases that 1,150 were in infants.

Stones may originate in the bladder, or start in the kidney and migrate downward, continuing to grow by accretion in the bladder. Many of the uratic, uric

FIG. 374.—PIECE OF RUBBER DROPPED THROUGH SUPRAPUBIC OPENING INTO BLADDER AND REMAINING THERE THREE WEEKS. Note the extensive incrustation formed in so short a time.

acid, and oxalic stones, or stones with these salts as nuclei, are of kidney origin, while the true bladder stone, usually dependent on obstruction and alkaline urine, is likely to be composed of phosphates or ammonium urate. Stones of considerable size are almost invariably of very mixed constitution.

Etiology.—The causes of stone formation, as mentioned in the last chapter,

FIG. 375.—HAIRPIN CALCULUS. The stones are mostly phosphatic. The hairpin had, as usual, been introduced through the urethra, although most of these patients pretend to be greatly mystified over the discovery of these evidences of previous misdeeds and evil habits. (F. R. Eccles, London, Ontario.)

are not altogether clear; but obstruction to the outflow of urine, as in enlarged prostate affecting the diseases or injuries of the spinal cord; bladder infection, and the presence of any foreign substance are the favoring conditions in the bladder. A foreign body in the bladder means inevitably stone formation in a very short time. This is illustrated in Figure 374. In the female, foreign bodies are sometimes introduced by mistake into the bladder and the hairpin seems a favorite instrument (Figs. 375 and 376). The patient is usually at-

tempting to produce abortion. Sometimes it is a rubber catheter, as shown in Figure 377. A curious formation about a suture which had awkwardly penetrated the bladder in a uterine suspension is shown in Figure 378. We have found a great variety of foreign bodies in the bladder, but nothing stranger than an onion stalk, at least six inches long, which a man of sixty had introduced through his urethra for causes best known to himself.

Size, Shape and Number.—Stones varying in size, from a small pea to immense structures weighing hundreds of grams, are met with. It is remarkable

FIG. 376.—HAIRPIN CALCULUS. Introduced in the usual manner *ab externo*, and not, as often pretended, by the mouth. (Specimen from E. V. Everitt.)

how free from symptoms a man can be with an immense calculus filling the bladder. The shape is almost as variable as the size; occasionally perfect jack-stones are met with. Most of the large stones are ovoid and occasionally an almost perfect sphere is found at operation. The concentric lamination and distinct nucleus so frequently found in large stones are illustrated by the specimen shown in Figure 379.

An interesting group of faceted stones is shown in Figure 380. The appearance of one of these almost identical concretions in cross-section is repre-

sented in Figure 381. Most frequently but one small stone is present, but occasionally hundreds are found.

Site of Stone.—Excluding those calculi fixed in the urethra and those found in narrow-necked diverticula, stones of the lower urinary tract are characterized by their exceeding mobility. With each change of posture the stone moves to seek the most dependent portion of the bladder. The position, especially during examination, may be greatly modified by the muscular contractions of the bladder wall, which form veritable shelves and pockets. Forming a distinct group by reason of the difficulties they offer in both diagnosis and treatment, are the fixed stones which occur in diverticula of the bladder. These

separate cavities, which may be either congenital or acquired, are favorite sites for stone: the condition is more fully treated in Chapter XXXI. These diverticula, when large-mouthed, allow the passage of the stone from the main cavity of the bladder to the recess and then back again. When the neck is narrow, as shown in Figure 382, the calculus is fixed and frequently becomes tightly adherent to the walls of the cavity.

Changes in the Bladder Due to Stones.

—A stone may remain long in the bladder, and, except for an occasional traumatism leading to temporary bleeding, cause no change whatever. Frequently there is merely a mild congestion. When, as is almost invariably the case sooner or later, infection and inflammation set in, all the changes characteristic of chronic cystitis develop. Ulceration is common.

FIG. 377.—INCRUSTATION ABOUT RUBBER TUBE. The patient had attempted to induce abortion, but had mistaken the urethra for the neck of the womb and slipped the tube into the bladder. It was removed in the sixth month of pregnancy through the urethra, through Kelly's open-air cystoscope. (G. L. Hunner, Nov. 17, 1902.)

Symptoms.—Probably all vesical calculi at the initial stage of their development are symptomless; some remain so for years. It is most astonishing that a history of only a few months of discomfort is obtained with many immense stone cases. Sometimes, however, an attack of renal colic is almost immediately followed by frequency of micturition and difficulty in voiding. The classical symptoms are: frequency of urination and pain on voiding, made much worse by exercise or by jolting, as in an automobile or on horse-

back; hematuria, fresh and principally terminal; and a sudden interruption of the stream during the act of voiding. This last symptom is common in females; rare in adult males; in infants it leads to nocturnal enuresis and occasionally to true incontinence. Male babies with this affection are often seen pulling at their prepuces.

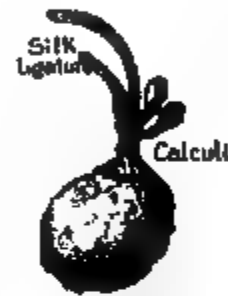


FIG. 378.—VESICAL CALCULUS. Due to incrustation on a silk ligature which by mistake had been passed through the bladder wall in an operation for suspension of the uterus. (Mrs. H., Apr. 5, 1901, J. H. H.)

When infection occurs the symptom-complex usually becomes that of a very severe cystitis, namely, frequency of urination and pain on voiding, great straining, and blood and pus in the urine.

Diagnosis.—The oldest, and often the most satisfactory, method is the employment of a metallic sound or searcher. For this examination about 200 c. c. of salt solution, plain water, or, better still, $\frac{1}{8}$ per cent. carbolic acid solution should be introduced into the bladder, and then the instrument used in a systematic method always seeking with its beak to make a dependent post of the bladder against which the stone will strike, giving the characteristic metallic click. Stones in diverticula or under folds, or in very irritable bladders, which

are constantly contracting, escape detection by this method even in the most skilled hands.

In the female large stones can easily be detected by the bimanual abdominal vaginal examination of the empty viscus. A large bougie coated with wax, if introduced, will show gouges from contact with the stone.

The cystoscope should always be used, as it gives information as to the size, number, and shape of stones not otherwise obtainable. It often shows the mouth of a diverticulum with the end of a stone projecting from it. It is advantageous in searching for a diverticulum to distend the bladder to the uttermost. When an open-air cystoscope is employed it is often possible to introduce a small metallic searcher into the neck of the diverticulum and so obtain the click.

The X-ray sometimes affords positive results where all other methods have failed. This was the case in a recent patient, where the stone was found in a diverticulum (Fig. 383). For the

FIG. 379.—SECTION OF A LARGE STONE REMOVED FROM THE BLADDER OF AN EIGHT-YEAR-OLD GIRL. Note difference of color and appearance at the center of the stone and between the central lamellæ from the peripheral ones. (From F. R. Eccles of London, Ont.)

best results in X-ray work the patient should be put on liquids for a day or two, the bowels thoroughly cleaned, and both bladder and rectum distended with air.

OPERATIONS FOR VESICAL CALCULUS.

A vesical calculus can be removed through the urethra, either by crushing it with a pair of forceps introduced through the urethra and drawing it out of the bladder through the natural channels, or by crushing the stone with a suitable instrument until the fragments are so small that they are readily washed out through the perineum (in the male), or the vagina (in the female), or above the symphysis pubis. Small calculi, the size of a pea, which have passed down the ureter, are commonly discharged spontaneously after they enter the bladder. A calculus, which is not over $1\frac{1}{2}$ cm. in diameter, of whatever length it may be, can be caught by forceps and gradually withdrawn through the urethra. A good way to do this is to place the patient in the knee-breast posture and to inspect the calculus through the open cystoscope (Figs. 384 and 385). One can see in this way just where it lies in the vertex of the bladder and pour a

FIG. 380.—EIGHT PYRAMIDAL STONES OF ALMOST IDENTICAL SIZE AND SHAPE (a). Found in a vesical diverticulum packed together as shown (b) and (c). (F. Larrimore, March 7, 1901.)

little sweet oil in to lubricate the parts during the extraction. Next, the measurement of the diameter and length of the calculus is easily made by taking the end of the cystoscope, whose diameter is known, as a unit of measurement. If the calculus is 12 mm. in diameter, it is well to dilate the urethra with Hegar dilators up to this extent; then, withdrawing the speculum, a stone forceps is introduced and directed to that part of the bladder in which the stone was seen to lie. On opening and grasping with the forceps, the stone is caught, brought up to the urethra, and gradually extracted. If the stone is grasped too near the middle, it can be dropped and caught again. The forceps holding the stone makes a wedge which opens up the urethra, while the blades of the forceps grasping the stone protect it from injury. A long foreign body, the only kind which nature permits to be introduced



FIG. 381.—TRANSVERSE SECTION OF ONE OF THE PYRAMIDAL STONES SHOWN IN LAST FIGURE. Note stratified structure, characteristic of all stones, showing that the stones, when small, were irregular in shape.

into the bladder, can be caught by one end through the speculum with a suitable instrument; and as the speculum is withdrawn, the instrument is drawn out and the foreign body with it. In this way a hairpin can be caught by its blunt end with a simple hook, drawn up into the lumen of the speculum and withdrawn through the urethra simultaneously with the speculum. In like manner a piece of the catheter can be grasped with an alligator forceps and withdrawn

FIG. 382.—REMOVAL OF STONE FROM DIVERTICULUM IN BLADDER THROUGH OPEN-AIR CYSTOSCOPE. The upper two figures show the front and side views of the condition. The dotted lines in the left upper figure indicate the incisions for widening the orifice of the diverticulum. In the left lower figure the diverticulum is laid wide open and the stone exposed. In the lower figure to the right, the removal of the stone through an open-air cystoscope is illustrated. (Mrs. J., San., March 3, 1909.)

through the speculum or with it. A calculus or a stitch in the bladder wall can be caught with the alligator forceps and withdrawn, and, if necessary, a knife or a pair of alligator scissors introduced to cut its loop and free it first. We did not encounter the slightest difficulty in removing the long pieces of glass catheter shown in Figure 386. By means of the open-air cystoscope it is possible to remove a stone from a diverticulum, as shown in Figure 382.

Lithotripsy and Litholapaxy.—For 250 years the perineal section for stone was reckoned as the greatest of surgical operations, and the instrumentarium employed, the deftness and rapidity in operation, and the success in saving life were the pride of the eminent surgeons throughout this long period in the evolution of surgery. Now the operation is almost displaced by

FIG. 383.—SKIAGRAPH SHOWING STONE IN VESICAL DIVERTICULUM. Another skiagraph taken with a fluid of lesser density, say 2 p.c. iodid of silver emulsion, would show the eccentric position of the stone. The small shadow to the right is a phlebolith. (Mrs. W. C. B., taken March 18, 1912.)

the simpler and safer one of crushing and washing out the stone at one sitting; while, as a surgical procedure, it has lost none of its historic dignity, it by no means approaches in difficulty the numerous abdominal and brain operations which are constantly undertaken.

Lithotripsy is the operation of crushing a stone with an instrument (Fig. 387) called a lithotrite, a stout instrument with a curved beak, which

FIG. 384.—DEMONSTRATION OF SMALL STONE IN BLADDER THROUGH OPEN-AIR CYSTOSCOPE. The stone is brought close to speculum by pushing up the anterior wall of bladder, lifting up calculus as on a shelf. (Mrs. S., Feb. 18, 1901.)

is introduced into the bladder and, with Young's instrument (Fig. 389), the stone is seen as it is grasped between the crushing blades. The blades are closed and the stone broken into two or several pieces. The bladder is then washed out and, the small pieces of stone being removed, a stone crusher is again introduced and the larger pieces of stone are caught and crushed as long as they can be distinctly seen in the medium. A lithotripsy done in this way is an operation about 100 years old, and, in skillful hands, is exceedingly successful. It is particularly adapted for phosphatic calculi, and those which easily break up into small fragments.

Litholapaxy.—In 1876 Bigelow introduced litholapaxy by an instru-

ment designed to crush vesical calculi (Fig. 387), and then, by means of a large, open, evacuating catheter with a pump attached, to irrigate the bladder and suck out the débris of the stone, the operations of crushing and washing out being continued until the entire stone was removed at one sitting (Fig. 388).

It is outside our purpose to go into a description of the mechanism of the aspirator, which can be found in various instrument catalogs. The operator ought to familiarize himself with the use of the catheter and the evacuator by washing sand or small pebbles out of a bottle filled with water into the receptacle. After testing and understanding the apparatus in this way it is not a difficult matter to apply it to the male bladder. All lithotriptic and

FIG. 385. — OPEN-AIR SPECULUM VIEW OF STONE SHOWN IN LAST FIGURE.

litholapaxic operations ought to be conducted with the utmost regard to asepsis. The various metal instruments which come in contact with the body can be sterilized by boiling or with formalin. If the patient has severe cystitis, it is of great advantage to keep him in bed for some days before the operation, and to wash the bladder out repeatedly with boric acid, or, better still, formalin solution. If he is extremely sensitive, it may be necessary to give a general anesthetic, but, as a rule, a local one, such as a 2 per cent. solution of eucaïn, is sufficient to diminish the sensibility of the urethra and the bladder. Cocain is dangerous and should not be used.

Before attempting to grasp the stone, the bladder should be distended with 100 to 120 c. c. of fluid. This obviates the risk of pinching the bladder walls

as the male and female parts of the instrument are brought together. It is well to keep account of the duration of the operations as well as to know

FIG. 386.—GLASS CATHETER SPLINTERED IN BLADDER DURING LABOR.

The five small pieces shown below were removed ten days after the accident through a No. 10 Kelly speculum.

the number of times the operator finds it necessary to open the beak of the instrument and to bring its parts together again to crush the stone to effect its complete removal. The skilled operator will markedly reduce the time and the number of the separations. By this means large calculi can be removed with-

out any injury to the patient in from a quarter of an hour to an hour, or more. Nitze has succeeded in removing a calculus "as large as an apple."

While an American, Bigelow, brought this operation to the front, it has been comparatively neglected in this country until quite recently. It has been used for years by English surgeons in India, particularly Freyer and Keegan, the latter of whom reports 10,073 cases. Although Nitze, Casper, Walker, and others have devised combined cystoscope and lithotrite instruments, the credit for devising an appliance of this character, which gives all the crushing power and evacuation ease of the Bigelow instrument, with the enormous advan-

2

FIG. 387.—BIGELOW'S LITHOTRITE. 1. The handle of Bigelow's lithotrite open and closed. Note the rough serrations which often blister the hands. 2. The jaws of Bigelow's lithotrite open and closed. Note the shallow female blade and the self-cleaning notches in the male blade.

1

tage of doing the operation under vision, is due to that ingenious surgeon, Hugh H. Young. His instrument is shown in Figures 389 and 390, and would seem to mark a new era in this work.

After the operation is over the cystoscope is introduced and the bladder carefully examined to see that there are no fragments left behind. The introduction of the cystoscope has given the final element of certainty to this delicate and conservative operation. As a final step, a 1 to 500 solution of nitrate of silver is injected, retained a little while, and then discharged and replaced by a boric acid solution. The patient should begin taking urotropin, in 20-gr. doses four times a day, before the operation, and continue for several days after.

Lithotripsy and litholapaxy cannot be practiced when there is a high grade of stricture of the urethra, when the prostate is very large, or when there is an extreme catarrhal condition of the bladder, rendering it intolerant of distention. It is only applicable to those cases in which the stone lies free in the bladder, and cannot be employed in cases of stone in diverticula.

Perineal Section for Stone.—The radical section of the perineum, the classical operation for vesical calculus, discovered by Frère Jacques, used by Rau

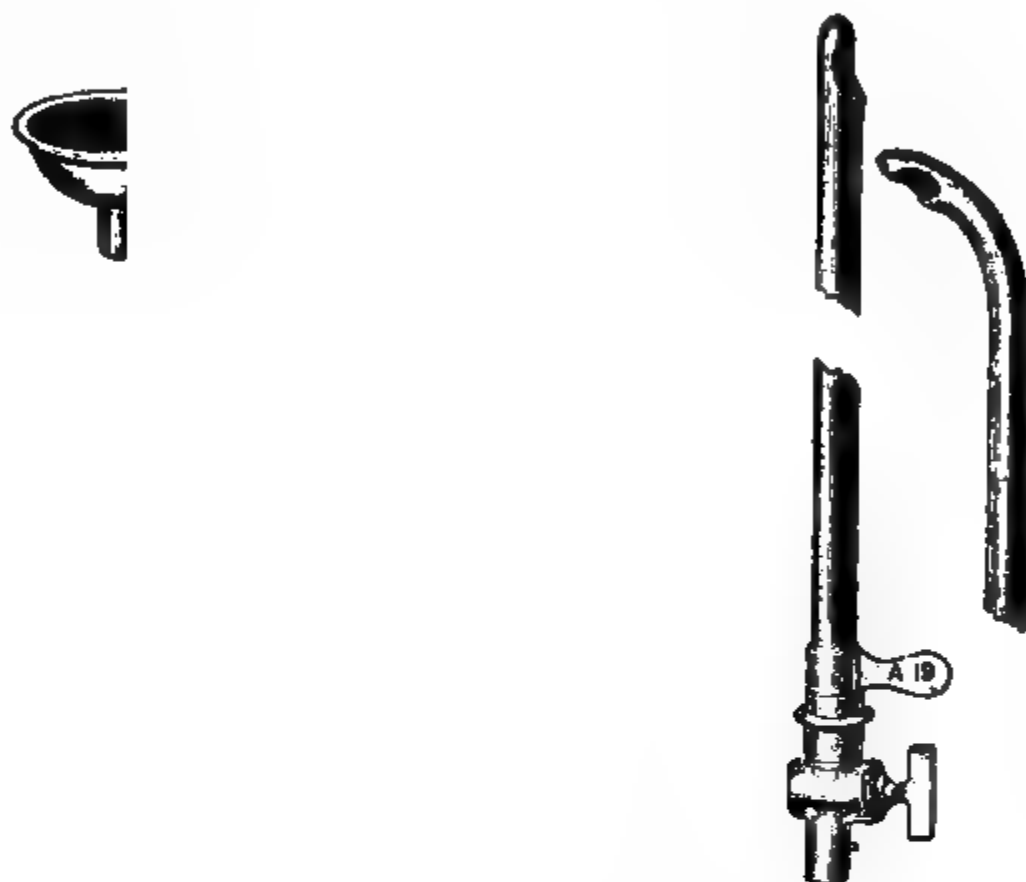


FIG. 388.—BIGELOW'S EVACUATING APPARATUS.

of Holland, introduced into England by Cheselden, and almost exclusively practiced by our own immediate predecessors, has largely been given up. When perineal section is used, a median section is preferred on account of the liability of the lateral incision to injure the ejaculatory duct. The median incision is made by putting the patient in the lithotomy posture. The assistant then holds the sound, with a deep groove on its convex side, introduced into the bladder, the scrotum is drawn up out of the way, and the surgeon divides the skin and the tissues immediately below it horizontally across the raphé for about 5 cm. The bulbus is exposed and the fibers uniting the sphincter ani muscles with the bulbo-cavernous muscles are divided. A groove in the catheter is then felt behind the bulb and marked with the nail of the left thumb, while the point of the knife is introduced into the groove and pushed forward into

or through the prostatic parts, according to the size of the stone. The stone is then grasped by a stone forceps and withdrawn. Nitze, whose description

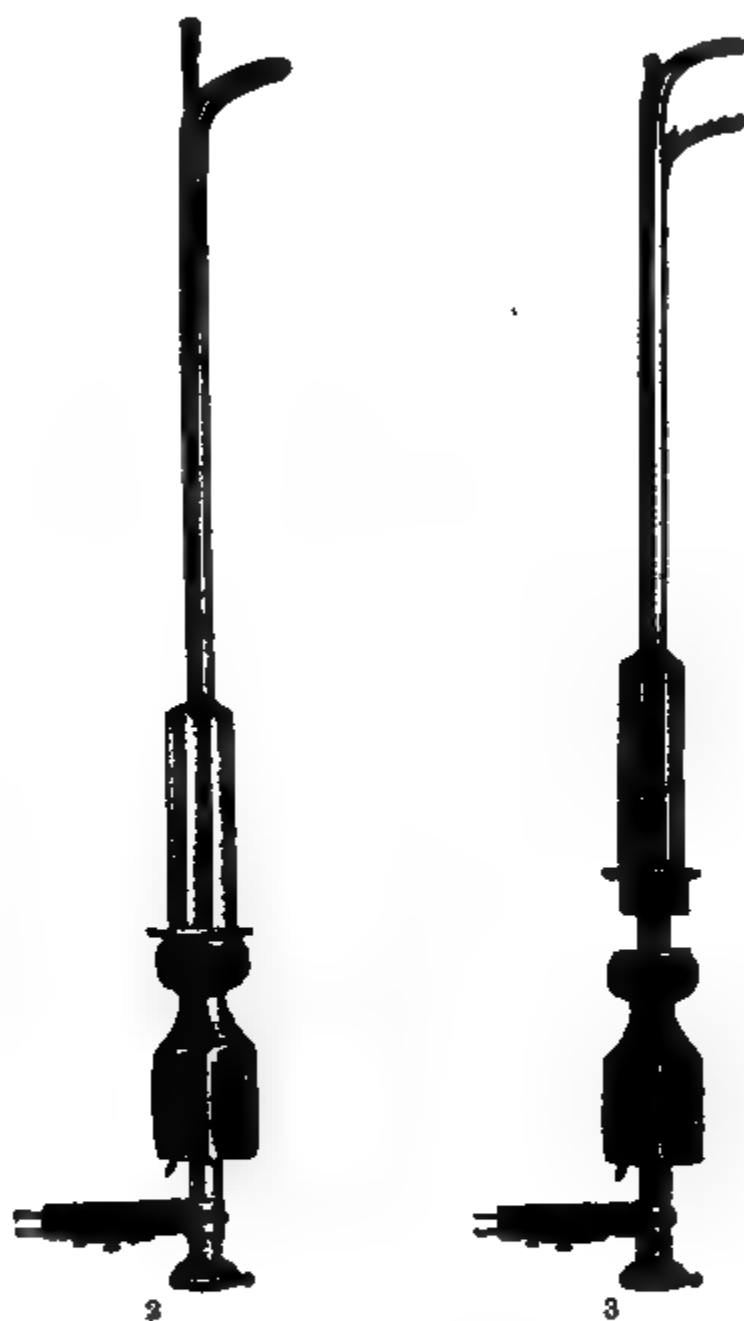


FIG. 389.—YOUNG'S COMBINED LITHOTRITE EVACUATOR AND CYSTOSCOPE. 1. Evacuator attached to lithotrite. The stop-cock, B, can be opened and closed while the evacuator is attached. 2. Long straight cystoscope inserted through lithotrite for examination of bladder. Beak of lithotrite closed, held against the anterior wall while the search is made for calculi with the cystoscope. 3. Blades separated, cystoscope looking out between the blades as when about to pick up a fragment.

we follow, quotes Volkmann as declaring that unexpectedly large stones can be removed by dilatation and without incision of the prostatic portions, he himself having succeeded in extracting a stone 3.5 by 2.9 cm. in this way without any

rupture. To complete the operation a catheter is placed in the bladder through the urethra, while the wound is lightly tamponed with iodoform gauze. It is likely that to-day more stones are removed by the perineal route through the bladder in cases of enlarged prostate glands, which require removal at the same time, than under any other conditions.

Vaginal Operation.—In women, in cases which cannot be treated by crushing (litholapaxy), the best method of removing a stone is through an incision in the vesico-vaginal septum, and this is best done by washing out the bladder thoroughly, then emptying it and placing the patient in the knee-breast posture. An open cystoscope is introduced and the stone

1

2

3

FIG. 390.—ENLARGED VIEW OF YOUNG'S LITHOTRITE. 1. Showing anterior fenestra for evacuation of fragments. Note the very shallow depression of the female blade. 2. Showing the handle with the cap removed exposing the evacuating nozzle and stop-cock, and showing the interior of the removable cap. Note the broad concave surfaces of the handle replacing the small rough serrations of Bigelow's instrument. 3. Enlarged view of Young's evacuator.

can be seen lying in the vertex of the bladder. By means of the cystoscope the bladder is filled with air. The posterior wall of the vagina is then lifted and retracted by means of a Sims' speculum, exposing the anterior vaginal wall (Fig. 391). The position of the internal orifice of the urethra in its anterior

wall is then carefully noted. This can be marked by introducing a mushroom catheter into the bladder and pulling it out until the bulbous end joggles at the internal orifice. A knife is then thrust into the vesical vaginal septum in the middle line and, with scissors or a knife, the opening is enlarged fore and aft. Then, a stone forceps is taken in the hand, introduced and opened, after which the stone is grasped and extracted through the cut at the base of the bladder and the vagina (Fig. 392). As a rule, it is well to close the wound up at once. Moderate and even rather severe catarrhal conditions of the bladder get well very rapidly when the distressing irritating cause is removed under irrigation through the urethra. If the catarrh is of unusual severity, however, the wound may be left partly open for drainage. The cystitis must then be treated during the convalescence. The wound may be closed with interrupted fine silkworm-gut sutures embracing all the layers except the vesical mucosa. A mushroom catheter may be inserted into the bladder through the urethra for drainage and for daily irrigation, until,

FIG. 391.—VESICO-VAGINAL INCISION FOR REMOVAL OF STONES IN BLADDER AND LOWER URETER. The incision is median and extends from the cervix almost to the internal urethral orifice. The patient is in the knee-breast posture and air is let into the bladder with a catheter. The knife is then plunged through the thin septum between bladder and vagina.

in about a week's time, it is safe to leave it out and let the patient urinate spontaneously.

Suprapubic Section or Sectio Alta.—When the stone cannot be crushed; when it is very large; when it is concealed by a diverticulum; when the prostate is large, but does not need removal at the same time; and for boys under fourteen years of age the suprapubic route offers a most satisfactory method of approach-

ing and extracting a calculus. While a general anesthetic is preferable, if the patient's condition forbids it, this operation can be readily done under a local anesthesia with eucain or novocain. After the bladder is thoroughly washed out a catheter is introduced through the urethra and a thin rubber tube or narrow gauze bandage tied around the penis. A transverse incision about 10 cm. long is made above the symphysis across the rectus muscle into the fatty tissues above and behind the symphysis. After dividing the overlying deep fascia the rectus muscles can readily be retracted without cutting them. As a rule, an assistant, by pulling strongly with a retractor just above the symphysis, will hold the muscles sufficiently apart to give a satisfactory exposure of the retroperitoneal space in which the bladder lies. After separating the muscles, most of the section should be done with the fingers or blunt instruments, to avoid opening the peritoneum. Should the peritoneum be cut by accident it must be closed at once with suture. The cellular tissue in which the bladder lies having been raised, a Davidson's bulb

FIG. 392.—REMOVAL OF STONE FROM BLADDER THROUGH A VESICO-VAGINAL INCISION. The patient is here represented as lying on her side, but the operation is best done in a frank knee-chest posture.

syringe is attached to the catheter and air pumped into the bladder until it rises into view in the wound, looking like a large egg. Be careful not to create an extreme dilatation in old patients, as the bladder has been known to rupture. When the bladder rises like a balloon into the upper part of the field of operation, it is well to catch and fix it by a fine black silk thread passed well through its coats on either side, or above and below, which serves to hold it up and steady it during the subsequent manipulations. The operator should note with care the point of reflexion of the peritoneum, which may be pushed back for several centimeters if necessary. He should avoid as far as possible any wide detachment

of the bladder from its enveloping fibrous tissues. The air-distended bladder can be so easily isolated by a little rapid, blunt dissection with the fingers that it is sometimes a temptation to free it in this way. If the stone is not excessively large the incision through the bladder walls is best made from side to side between the threads. As soon as the mucosa is opened the air escapes and the bladder tends to collapse, but the opening is held well up by the threads introduced for this purpose. The patient should now be elevated in the Trendelenburg position, which frees the bladder from pressure of the viscera above, allowing a better expansion and exposure. A retractor is now introduced into the bladder, and nothing is better at this juncture than the narrow blade of a Sims' speculum. Any fluid in the base of the bladder is removed by suction or by stuffing it loosely with gauze. It is well during these and subsequent manipulations to protect the edges of the incision and the surrounding parts with gauze, so as not to infect the wound. The wound is then enlarged with scissors or a knife until it is big enough to permit the extraction of the stone. The various steps of this operative procedure are shown in Figures 598-602. If there is much catarrh in the bladder one may follow Nitze's suggestions and add a boutonnière operation, draining the bladder with a good-sized rubber catheter through the peritoneum. Nitze, after the fashion of a retrograde catheterization, introduces a long, slender forceps through the internal urethral orifice, and, pushing its point down against the perineum, between the anus and the bulbus, cuts down on the point of the forceps, thrusts it through the perineum, and grasps a Nélaton catheter No. 33, drawing it into the bladder. In this way the wound is drained while the suprapubic incision is healed.

CLOSURE OF THE SUPRAPUBIC INCISION INTO THE BLADDER.—The suprapubic opening into the bladder ought not to be completely closed when the infection is so severe as to make the attempted closure hopeless. The wound in the bladder may be closed with either silk or catgut. Fine silk makes a good closure when there is no infection. It may be used as a continuous suture from end to end, passing through all the tissues except the mucosa, and buttressing the muscularis and the edges of the incision against each other. After placing the first layer of suturing, the second layer of catgut should be inserted above the first, this time grasping only the muscular outer coat of the bladder from end to end, great care being taken to overlap the ends of the incision where a leak is most likely to occur. The third most important suture is the one uniting the perivesical fascia. Often it is well to rely on this alone. If catgut is used throughout, it must be prepared with cumol and formalin or weak chromic acid, so as to prevent its too speedy absorption and the breakdown of the wound. The effect of the suturing of the bladder should be to

unite the margins of the incision and the vesical walls for about 5 mm. to either side of the incision in such a way as to invert a ridge in the direction of the bladder.

After closing the vesical wound in this way, with every possible precaution to prevent contamination of the wounded tissues outside of the bladder by infected urine, the operator proceeds to close the rectus fascia and finally the abdominal incision by interrupted silkworm-gut sutures, passed figure-of-eight fashion from the skin through the fascia and back through the skin on the opposite side. Under these circumstances the lower angle of the wound should be left open and a little rubber tube, not more than 1 cm. in diameter, be inserted, wrapped up in iodoform gauze and protective. This may be left in place from three to five days, until it is evident that there is no infection and that the wound is not going to break down. When there is a bad infection the vesical wound will, as a rule, break down, and, for this reason, it is better to anticipate this accident and leave a small opening in the bladder. A mushroom catheter is inserted into the bladder through the opening, filling the orifice so completely that all the urine escapes through the catheter and is conducted into a receptacle at the side of the bed, discharging under carbolic acid and water. If the surrounding tissues have been soiled an additional drain must be placed adjacent to the catheter so as to provide for any infection in Retzius' space. With the suprapubic drain, and with a perineal drain or with a catheter inserted into the urethra, the bladder can be kept empty and irrigated freely.

When the catarrhal process is cured it will often be necessary to free the bladder from its skin attachment, so as to get rid of the diverticulum at its top, which may lodge an infection and become the cause of repeated abscess formations.

URETHRAL STONES.

A stone is rarely found lodged in the urethra in a woman on account of the shortness and the greater laxity of the canal, as long since noted by Celsus. The female urethra only presents one point of marked obstruction, namely, the external orifice. Stoeckel counts 19 cases in the literature, mostly in women over 40 years of age. Quénu and Pasteau (*Ann. d. mal. d. org. génito-urin.*, 1896, xiv, 289) have carefully reviewed the literature of the subject and issued an elaborate paper dealing more particularly with the suburethral calculi found in pockets adjacent to the urethra.

Finsterer (*Dtsche. Ztschr. f. Chir.*, 1906, lxxxi, 140) has studied urethral calculi in both sexes, including many in children, with numerous valuable references to the literature (Fig. 393).

Jobson (*Amer. Jour. Med. Sc.*, 1902, cxxiii, 16) reports two cases of impacted calculi in boys three and three and one-half years of age. The stone in both cases was removed by urethrotomy, posterior to the scrotum. The first child had urinary extravasation, due to rupture of the urethra, and died with rash and high fever, while the second recovered.

T. Holmes, in his "Surgical Treatment of Disease in Infancy and Childhood," 1868, says that when summoned to a case of retention in a child we may almost always assume that it is due to an impacted calculus in the urethra.

The stones are either intra-urethral, that is, lying in the canal of the urethra; or sub-urethral, that is, lying in a diverticulum underneath the urethra but connected with it. This latter form is also called diverticular or urethrocele calculus.

Again, some large stones lie partly in the urethra and partly in the bladder, and are vesico-urethral. Usually there is but one stone, but sometimes there are several. In a diverticulum they may exhibit numerous facets, with a nice mutual adjustment by their flat surfaces, while the entire conglomeration forms a well-defined ovoid body filling the sac (Fig. 393).

The origin of the stone is usually from the side of the bladder. It may escape from a ureter and then pass through the bladder and lodge in the urethra, as in Halban's case

FIG. 393. — PIPE-SHAPED ARTICULATED CALCULI LYING IN A URETHRAL DIVERTICULUM AND EXTENDING INTO THE URETHRA. (J. Finsterer, *Dtsch. Ztschr. f. Chir.*, 1906, lxxxi, 149.)

(*Centralbl. f. Gynäk.*, 1903, xxvii, 374), where an elderly patient had a urate stone, the size of a bean, extracted from the urethra, an immediate cystoscopic examination showing a marked laceration of the right ureteral orifice, through which the stone had clearly passed. These calculi are appropriately called wandering stones.

Again, the stone may have formed about the nucleus of a rough fragment which had escaped from the bladder and lodged in the urethral folds. Around this central point the phosphates and carbonates accumulate until the original fragment becomes a mass of considerable size. Again, a stone may form around a foreign body introduced into the urethra, notably a needle or a hair-pin, or, as in the case of a man reported, around a stalk of grass. A stone

originating in the urethra is autochthonous, as contrasted with the wandering stones.

Calculi found eccentric to the urethra and in a diverticulum, may either be formed there primarily, or the calculus, first formed in the urethra, may so displace the inferior urethral wall as to create a diverticulum for its lodgment, when communication with the urethra is a large one and more of the nature of a sacculation.

Halban reports (*Centralbl. f. Gynäk.*, 1900, xxiv, 659) a woman, 79 years of age, who had had a utero-vaginal prolapse for 25 years, and for six years suffered from either retention of the urine or incontinence. The urethra was choked with five stones, varying in size from a pea to a hazel-nut. After removing these with a forceps, the bladder itself was found full of stones, concretions of uric acid with phosphatic coating.

Clinical History.—If the tumor has lodged in the urethra, after escaping from the bladder, the symptoms may be urgent on account of the sudden obstruction to the passage of the urine; this is oftener observed in the male sex. The patient is seized with distressing sensations of bearing down and straining which may become acute and result in an abscess or even extravasation of urine in a male. On the other hand, if the calculus is small and forms in a diverticulum, the first sensations are apt to be a local discomfort, a sense of heat, difficulty in walking, and difficulty in urination, especially if a cystitis supervenes. There may be a sensation of a foreign body in the parts and decided pain. Direct pressure of any kind aggravates the distress. A large calculus may even perforate the urethro-vaginal septum and escape by way of the vagina. A stone in a diverticulum does not interfere with the outflow of the urine. Chrobak had a case of a young woman who suffered from dysmenorrhea until he removed a small diverticular calculus.

Diagnosis.—This is readily made when inquiry discloses discomforts connected with the bladder and pus is found in the urine, while a local examination reveals a hard, tender spot in the urethra or a hard tumor like a urethrocele projecting from the lower anterior vaginal wall. Several calculi in a pocket give a sense of crepitation. On conducting a metal sound into the urethra it hits against an obstruction, or, if appropriately curved, it enters the pocket where the stone is lodged. A catheter coated at its tip with wax will reveal gouges and scratches. One must not confuse the suburethral prominence with a tumor of the soft tissues.

Gellhorn (*Ztsch. f. Geburts. u. Gynäk.*, 1908, lxii, 147) has published a case of a vaginal cyst of the anterior wall immediately behind the urethral prominence, which, on removal, was found to contain a soft phosphatic stone.

He conjectured that it originated in a unique way from a urethral diverticulum, which had become closed. An X-ray plate, so exposed as to avoid the shadow of the symphysis, ought to show the stone with an opaque catheter alongside of it, as well as the presence of any other stones in the bladder, or in the ureters, or in the kidneys, which should always be included in the examination.

Treatment.—A stone can be removed in one of two ways: either by the external urethral orifice or by a vaginal incision. In one case a soft catheter introduced into the bladder for irrigation was so firmly wedged in by a urethral calculus that it could not be withdrawn, so it became necessary to extract it transvesically through a suprapubic opening. If the stone is a small one, or if it can be crushed easily as it lies in the urethra, it is well to take it out by the external urethral orifice, which can be dilated, after incising the outer orifice up to 14 mm. in diameter or even more, without injury.

When the stone, or stones, rest in a diverticulum, the proper plan is always to remove them by cutting into the diverticulum, ending by resecting the sac, taking particular pains to extirpate its entire mucous lining, and cutting out a wedge of the vaginal tissues so as to form a urethra of the proper size. The resected area is then closed with two tiers of catgut sutures, the external portion being splinted with a few of fine silkworm-gut.

A vesico-urethral calculus of large size, particularly one forming about a foreign body (hairpin), should, as a rule, be extracted suprapubically. If the woman has borne children, a large stone can be more conveniently removed through the base of the bladder, after which the bladder should be drained, if there is much cystitis.

CHAPTER XXII.

SYPHILIS, ECHINOCOCCUS, ACTINOMYCOSIS, AND OTHER PARASITIC DISEASES OF THE URINARY ORGANS.

SYPHILIS.

Syphilis plays a comparatively unimportant rôle in the surgical diseases of the kidney, ureter, and bladder. The best known and most frequent lesion is chancre of the urethra. It is not our place to consider its treatment, which is fully discussed in many text-books on venereal diseases. It is a hard, indurated nodule. The spirochete can be demonstrated. It should be thoroughly cauterized and general syphilitic treatment instituted.

Syphilis at any stage may lead to nephritis. Occasionally in the acute stage of the secondary period an acute nephritis develops; some of these "kidneys" pass over into chronic parenchymatous nephritis. I. Neumann (Nothnagel's "Specielle Pathologie und Therapie," 1899, xxiii, 684) states that albuminuria is a common symptom in every stage of syphilis. That parenchymatous, chronic interstitial, and gummatous nephritis may occur singly or in any combination is well known. Amyloid disease is also common in tertiary syphilis. Fournier, quoted by Legueu ("Traité chirurgical d'urologie," 1910, 690) observed syphilitic nephritis in only 9 out of 3,429 cases of nephritis. The first observer to note the association between syphilis and nephritis was Rayer.

Gummata of the kidney do not appear to be so very rare; there are a number of specimens in the pathological museum at the Johns Hopkins Hospital. Spiess (Inaugural Dissertation, Berlin, 1877) found this lesion seven times in two hundred and twenty autopsies performed on syphilitic subjects. In nearly all observed cases only one kidney is involved. Usually the gummata are multiple, and rarely lead to the formation of large tumors. None of the cases obtained from the pathological records at the Johns Hopkins Hospital gave any distinctive symptoms during life. James Israel (*Dtsch. med. Wchnschr.*, 1892, xviii, 5) has reported two cases of gumma of the kidney. In the first, a woman of 23, a tumor in the right kidney region developed, associated with attacks of colicky pain, frequent micturition, and fever.

There was a definite history of syphilis and pronounced signs of the disease elsewhere. The urine was clear, except for a few pus cells, and contained albumin. The second case occurred in a man of 39, who gave a history of disturbances of micturition and showed a tumor in the side; his urine contained pus and albumin. In both instances Israel removed the kidney and substantiated his clinical diagnosis by microscopic examination. No cystoscopic or collateral data are given. Both patients recovered promptly.

Syphilis of the ureter is the greatest of rarities. Proksh (*Archiv f. Dermat. u. Syph.*, 1899, xlviii, 221) has collected all the cases reported in the literature up to his time.

Syphilitic lesions in the bladder were but little known until quite recently. The widespread employment of cystoscopic methods is showing many more cases than were formerly known. Hurry Fenwick reports a case of condylomata observed in an autopsy upon a young man of 23 years, who was killed by accident, and at the time was suffering with syphilitic lesions. G. MacGowan (*J. Cutan. and Genito-Urin. Dis.*, 1901, xix, 326) reports the cystoscopic observation of several ulcers behind the right ureteral orifice, due to gummata.

Margulies (*Ann. d. mal. d. org. génito-urin.*, 1902, xx, 385) reports three cases. In the first there were polypi; in the second, ulceration; and in the third, cystitis. All were observed carefully and all yielded to ordinary anti-syphilitic treatment.

While keeping in mind the possibility of syphilis it is well to recognize its rarity in connection with urological diagnosis. Practically all cases observed have shown marked evidence of syphilis elsewhere. The Wassermann reaction should afford a great help in the diagnosis of obscure cases. Even in the presence of general syphilis, caution should be observed in pronouncing it as the cause of an observed bladder or kidney lesion. All other conditions with which it can be confused must be excluded.

It is probably rarely ever necessary to follow Israel's plan of removing the gummatous kidney, although his results were most gratifying. The treatment should be that accorded to syphilis elsewhere in the body. A complicating secondary infection would demand surgical interference.

ECHINOCOCCUS DISEASE.

The embryo of the *Tænia echinococcus*, a common intestinal parasite of dogs, develops in the human body and causes the formation of cysts, which vary

in size from small growths, the size of a marble, to very large tumors. These cysts are occasionally met with in the kidney and in the tissues surrounding the urinary bladder. The avenue of infection is the gastro-intestinal tract and then the blood-stream. The eggs of the parasite are swallowed in food and begin to develop in the stomach and upper intestine. The new-formed embryos first break into the portal circulation and pass to the liver. In order to reach the kidney they have to pass through the right heart, the blood vessels of the lungs, the left heart, the aorta, and the renal arteries. The disease is rare in the kidneys, as would be expected, when the mode of infection is considered, and yet the kidney would seem to be a fertile ground for the parasites to develop in, as the proportion of cysts here is almost as great as in the lung, and at least one-tenth as frequent as in the liver. The cysts in the perivesical tissues seem to be sometimes infected, 112 times in 2,474 cases. Cranwell and Herrer Vegas (*Revista, de la Soc. méd. argentina*, 1904, xii, 215) found 36 instances in 1,696 cases.

ECHINOCOCCUS DISEASE OF THE KIDNEYS.

According to some statistics women are more subject to kidney lesions in the echinococcus disease than men. Garré and Legueu express this view; on the other hand, in some statistics, male subjects predominate.

The two kidneys are rarely affected at the same time. The relationship between right-sided and left-sided cases shows no essential difference in numbers.

The common age of occurrence is between 20 and 50 years of age. No age, however, is immune. Nicolich (*Ann. d. mal. d. org. génito-urin.*, 1908, xxvi, 1773) records the condition in an infant three months old.

Pathological Anatomy.—The typical location of the cyst in its early stage is in the cortex of the kidney. It may start in any part of the kidney and, very rarely, in the perirenal fat. During its development the cyst shows a marked tendency to push through the medulla, down to the pelvis of the kidney, into which it may rupture. Not infrequently the development is at one pole or the other, the opposite pole in such a case presenting a normal appearance. As the cyst develops it presses the kidney tissue together and causes atrophic changes, and, in very large cysts, the kidney parenchyma may be spread out over the wall almost as in hydronephrosis.

In its early development the wall of the cyst is thin and translucent; as it grows the wall becomes thick and fibrous, and, in many instances, impregnated with calcareous deposits. There is no sharp line of demarcation between the kidney parenchyma and the cyst wall, which renders anucleation impossible. The cyst may be solitary, but is frequently multiple. Cysts have been observed

in solitary kidneys a number of times. Kidneys, the seat of hydatid cysts, may show other pathologic conditions, such as stone, hydronephrosis, or, as observed by Legueu in one instance, tuberculosis. In the course of their development these growths show a marked tendency to perforate into contiguous organs, though rarely into the peritoneum. The common point of rupture is into the pelvis of the kidney; some authors place the frequency of this complication as high as 75 per cent. Nicaise ("Thèse de Paris," 1905) found it 134 times in 357 cases, a percentage of 37.5. Occasionally the rupture is into the stomach or

FIG. 394.—SEDIMENT FROM ECHINOCOCCUS CYST. Above and to the left are two degenerated scolices (x about 60); to the right is the head of a scolex (x 400); below are hooklets of various shapes and a small mass of cholesterin crystals (x 400). (After Emerson.)

intestines, sometimes into the pleural cavity. Sometimes an entire cyst is discharged through the ureter into the bladder and spontaneous healing occurs.

Symptoms.—As a rule the cysts develop very slowly over a period of years. Frequently the appearance of a tumor in the side is the first symptom. In some patients there is dull pain in the loin. Very large cysts may cause a variety of symptoms due to pressure on surrounding organs. Rupture into the peritoneum may cause sudden death. Rupture into the intestine is followed by pyonephrosis with all its manifestations. When rupture occurs into the renal pelvis, there follows, as a rule, very severe renal colic, and the passage of blood, pieces of cyst membrane, and parasites in the urine. The duration of such attacks varies from a few hours to days. The interval between them varies from short periods of a few days to years. Death rarely occurs from such a rupture, and immediate infection is the exception. Wherever infection occurs the picture becomes that of pyonephrosis.

Diagnosis.—This is rarely made before the presence of a tumor or rupture

into the pelvis of the kidney has occurred. The discovery of the hooklets shown in Figure 394 during a urine examination is pathognomonic of the disease. The size of the cysts varies from a pea to a man's head. In a few instances a skiagraph has shown the presence of a tumor before it was distinctly palpable. When the wall of the cyst is calcified it is easy to understand how the X-ray produces a good shadow. During the period when the contents of the cyst are discharging in the urine a diagnosis is readily made by finding parts of the cyst wall and the typical hooklets of the parasites. Manasse, who cystoscoped a patient during the discharge of the cyst, through the ureter, actually observed the passage of the material down from the kidney. Before rupture the diagnosis is made by careful palpation and cystoscopic studies, combined with examination of the blood. By means of ureteral catheterization and the functional tests, the confusion between these cysts and those of the ovary, liver, and spleen, should be avoided. By pelvic measurements hydronephrosis also can usually be excluded. The various simple cysts of the kidney, polycystic kidney, and the neoplasmata of the kidney offer greater difficulty. Occasionally it is possible to detect the often described fremitus of these cysts. They are rarely fluctuant. In many cases of hydatid disease the blood shows a marked eosinophilia, which has been known to reach as high as 50 per cent. of all the white blood cells. To this useful blood analysis has been added the reaction of complement fixation described by Laubry and Parvu (*Bull. soc. méd. d. hôp. de Par.*, 1908, 2s., xxvi, 211-226; 891-900). This would seem to be a great step in the diagnosis.

Prognosis.—This is all but impossible in the individual case. Cysts occasionally remain small for years and occasion no symptoms; at other times they develop rapidly and lead to most serious complications. The prognosis is bad where both kidneys are involved and in those cases where there is but a single kidney.

Treatment.—The treatment is operative in every case, preferably as soon as the condition is diagnosed. The character of the operation should depend on careful preliminary studies of the function of the involved kidney and upon the findings at operation.

When the kidney is well preserved, and the cyst extrarenal or attached to it by a small pedicle, the cyst should be removed and the kidney left intact. This favorable condition is but seldom encountered.

When the cyst is located at one pole and the other pole is normal, the kidney may be *resected*, provided there has been no rupture. This can only occur with cysts of moderate size. It has been successfully carried out a number of times.

Where but little parenchyma is left, or where resection is impossible, and often where infection is present, *nephrectomy* is the operation of choice. It should be undertaken, however, only in tumors of moderate size, which can be removed by the extraperitoneal route. This has actually been carried out in a number of cases. Nicaise noted that in 22 transperitoneal nephrectomies there were 7 deaths due to the operation, and in 12 lumbar nephrectomies, one death. Before nephrectomy, just as in all other kidney diseases, the operator must be sure that the opposite kidney is capable of carrying on the function of both.

Incision and drainage, the oldest of operations, is quite simple and leads to good results in most cases. Its disadvantage is that it takes from four months to a year for the fistula to heal. Urinary fistula following this procedure is very rare. Great care must be exercised in preventing implantations of the disease in the incision. This can be avoided in two ways: first, by a two-stage operation, the cyst being exposed and its wall sutured to the skin, while, at a second sitting, the wall is incised with a Paquelin cautery, the contents evacuated and the cavity filled with iodoform gauze; second, by injecting a sterilizing solution of some kind into the cyst after its exposure. Bichlorid of mercury, 1 to 1,000, or, better still, formalin, 1 to 100, may be used. After injection the operator waits a few minutes and then opens the cyst with the precautions already noted. If the cyst wall is not too rigid, it is a great advantage, after sterilizing with formalin, to remove the interior of the cyst, to sew the walls together with catgut sutures, and close the incision with a drain down to the walls. When successful, this mode of treatment reduces the time of healing to a few weeks in place of months.

HYDATID DISEASE OF THE BLADDER.

This is secondary to hydatid of the peritoncum. The cysts may rupture into the bladder and cause marked vesical irritation. Tumors in this locality are really pelvic cysts and must be distinguished from cystic tumors of the pelvic organs. The diagnosis can occasionally be made by consideration of the points already given in diagnosing hydatid of the kidney. The treatment is by peritoneal incision and drainage.

BILHARZIOSIS.

This is a parasitic infection of the urinary organs by a trematode worm, first described by Bilharz (*Ztschr. f. Wiss. Zoölogie*, Leipzig, 1852, iv, 72-76).

The parasite has been called the *Schistosoma hematobium*, or *Distoma hematobium*. The habitat of this worm is the veins surrounding the bladder, urethra, and lower bowel. The lesions in the urinary organs are due to the presence of the eggs of the parasites (Fig. 395). The bladder and urethra are the principal foci of the disease. The ureter is more rarely involved, and the kidney but seldom.

Mode of Infection.—Human beings develop this disease through the drinking of water containing the parasite or its eggs. This can be considered the first stage, one which manifests itself by no symptoms. In the second stage young parasites pass through the intestinal wall and gain access to the portal vein system. In the portal vein one rarely finds fully developed worms, and the symptoms are not characteristic. The third step is the passage of the parasites into the veins about the bladder and the urethra and ureters. This occurs through the anastomoses between the hemorrhoidal veins and the veins surrounding the urinary organs. On reaching these latter veins the parasite attains its adult form (Fig. 396), and the female begins laying eggs, which are present in the mucous membrane of the bladder, urethra, and ureters. The muscular coats of the bladder are free from eggs, but they are present in the perivesical tissues. The eggs break through into the bladder and are discharged with the urine.

FIG. 395.—CHARACTERISTIC GROUP OF EGGS OF THE *BILHARZIA HEMATOBIA*.

Occurrence.—The disease occurs principally in Africa and notably in Egypt. Kautsky, quoted by Legueu (*Traité chirurgical d'urologie*, Paris, 1910), found the eggs in the urine of 97 out of 124 children in one of the schools in Cairo. The infection comes from drinking contaminated water. It is much commoner among the lower classes than the upper, and in the United States is an exceedingly rare affection. R. O'Neil (*Boston Med. Surg. J.*, 1904, cli, 453) states that only six cases had been recorded up to his time.

Description of the Parasite.—Contrary to most trematodes the males and females are quite different in appearance; the adult male worm is from 12 to 14 mm. long, and has two openings on its ventral surface; the anterior one is free, the posterior holds the worm on to its attachment. There is a groove along the ventral surface of the male worm into which the female enters. The female is a long, thin worm, 20 mm. long, and has a distinct uterus, filled with eggs

(Fig. 396). The eggs of the parasite are large, measuring .16 by .6 mm., and often contain a ciliated embryo. The shell of the egg is quite transparent. Stained with hematoxylin, the living eggs are blue, the dead ones violet. In the veins of the bladder this is the form of parasite observed. In the portal vein the male is about 3 mm. long, and the female, 6 mm.; these are young parasites and the sexual character has not developed. These eggs and parasites may exist for years, and many of them undergo calcification.

Pathological Anatomy.—The reader is particularly referred to the excellent paper of Goebel (*Centralbl. f. d. Krankh. d. Harn.-u. Sex.-Org.*, 1906, xvii, 594-615), and that of Letulle (*Bull. et mém. de la Soc. anat.*, 1909, lxxxiv, 249-273).

The lesions in the bladder at the earliest stage are little patches of hyperemia. A little later these become yellowish-gray, and are slightly raised. Microscopic examination of such a patch shows the epithelium thickened and often spreading downward into the sub-mucous tissue. Between the epithelial cells free eggs are rarely seen, but little cysts, large enough to be seen by the naked eye and filled with leukocytes, are often visible. The deeper layers of the bladder are congested and edematous. In a later stage patches of ulceration and granulation occur with great thickening of the bladder. This is the stage shown in Figure 397, a specimen kindly sent us by Dr. Juridini, of Cairo. The number of eggs, which stands out beautifully in microscopic section, varies greatly.

FIG. 396. — SCHISTOSOMA HEMATOBIIUM. Adult worm. (From Braun.)

In advanced cases the bladder is greatly thickened and covered with ulcers and polypoid excrescences; not infrequently fistulæ occur through the abdominal walls. The picture may be greatly altered by the presence of secondary infection, usually due to the colon bacillus. Goebel has pointed out that not only do stones form in a great many cases, but that malignant tumors,

both cancerous and sarcomatous, likewise develop in some of the advanced cases.

The lesions in the urethra, frequently involving its entire length, correspond to those in the bladder. Strictures and fistulae are very common.

Involvement of the ureter at its lower end is common; at its upper part rare. The kidney is practically never affected, although eggs of the parasites have been found in it in certain rare instances. The lesions in the ureter correspond to those in the bladder.

Hydronephrosis occurs in some cases of the disease from occlusion of the ureteral lumen.

Symptoms.—The disease is extremely slow in its development, usually extending over a period of years. The severer complications do not occur in most of the cases.

Complete healing is rare, for, even after the death of the parasites, the presence of the egg may give trouble for years. In the early stages the cardinal symptom is hematuria, which occurs at irregular intervals. The eggs may be discharged in urine in which there is no blood. There may be marked irritation of the bladder, even before secondary bacterial infection occurs. The commonest cause of secondary infection is instrumentation. In the later stages, when the bladder is no longer able to contract, the suffering may be intense, particularly where there are constitutional effects due to complicating infection. In non-suppurative cases the blood shows a secondary anemia and eosinophilia. There are few constitutional symptoms and no fever.

FIG. 397.—PORTION OF BLADDER VIEWED FROM INTERIOR SHOWING LESIONS DUE TO *BILHARZIA HEMATOBIA*. The papillary excrescences are shown actual size and represent the changes in the bladder mucosa due to the ova of the parasites which are found everywhere in the walls of the bladder. Note the small cyst at right upper margin of specimen. (From Dr. Juridini, Cairo, Egypt.)

Diagnosis.—This trouble should be kept constantly in mind in localities where the disease occurs, and in every case of hematuria in patients who have lived in such localities. Proof that the disease is present depends on finding the typical eggs of the parasite in the urine (Fig. 395).

Treatment.—No treatment has proved curative. Infection may be guarded against and, to some extent, controlled by the usual internal medicaments and local treatments employed in cystitis. Operative treatment is confined to those cases in which there is a retention of the urine, which requires suprapubic, perineal, or vaginal drainage of the bladder.

ACTINOMYCOSIS.

Etiology.—It has been stated that the organism *Actinomyces bovis* is occasionally found growing in different kinds of grain, and that these grains, eaten in the raw state, are the exciting cause of the disease. This view is not in accord with the biologic characters of true *Actinomyces bovis*, as first accurately described by Wright (*J. Med. Research*, 1905, xiii, 387), and the chief argument against it is the fact that pure cultures of the organism are anaërobic. Nevertheless, the disease is especially prevalent in agricultural districts.

Actinomycosis can be communicated from animals to man, and from man to other human beings by direct contact under favoring conditions. Diseased gums, bordering on carious teeth, frequently give a point of entrance to the germ. When once the disease has become established in the system it spreads by continuity and by metastasis. In 632 cases in which the primary focus was given, Ruhräh (*Ann. Surg.*, 1899, xxx, 431) found that the head and neck were affected 359 times, or 55 per cent.; the digestive tract 132 times, or 19 per cent.; the pulmonary tissue 92 times, or 14 per cent.; the skin 16 times, or 2 per cent.; and there were 33 doubtful cases, or 5 per cent.

Pathology.—The chief characteristic of the suppurative process caused by this germ is the presence of characteristic granules which are composed of aggregates of the branching filamentous microörganisms. The granule, which is one to two mm. in diameter, is usually of a sulphur-yellow color, but it may be grayish or even greenish. Seen under the microscope the granule is made up of numerous club-shaped bodies which are disposed radially, whence the name "ray-fungus." Actinomycosis must be clearly distinguished, according to Wright, from streptothrix, cladothrix, and oöspora. Wright has shown that the only name tenable for this latter group is "Nocardia."

When the fungi enter a tissue they begin to grow in the characteristic radial way. Around the organism inflammatory reaction takes place, with the formation of granulation tissue arranged in circular zones. Calcification may occur, and the process thus come to an end; but it is far commoner for it to go on, and, after a time, the granulation tissue undergoes necrosis. Pus is then formed and a small abscess results. The destructive process caused by the disease is often very extensive. It has been known to start in the jaw, extend along the neck, gain a foothold in the lungs, travel through them, attack the diaphragm and invade the organs below. Coexistent pathogenic bacteria undoubtedly play an important part in causing rapid extension of the disease. Although spreading by a process of gradual encroachment is more common, yet in many instances the disease is carried by metastasis. Both the blood-vessels and the lymphatics may assist in carrying the germs, but especially the blood-vessels.

It is doubtful if the kidney is ever the organ first attacked, and the disease probably always reaches that organ either by metastasis or by continuity. In the reports of 128 autopsies, collected from various sources by Garceau ("Tumors of the Kidney," 1909), in which actinomycosis of some organ was noted, metastatic actinomycosis of the kidney was found in 11 instances, or 8.6 per cent.; in 11 other cases the kidney was affected by continuity; in 2 cases there was doubtful primary actinomycosis; and in one there was actinomycosis of the ureter. Besides these autopsy cases, there were 2 instances of actinomycosis of the kidney, apparently primary, with nephrectomy and recovery. One is given by Israel ("Chirurgische Klinik der Nierenkrankheiten," Berlin, 1901, 270) as occurring in a male, aged 33; the other is from Kunitz (*Dtsch. Ztschr. f. Chir.*, 1908, xcii, 181), in a boy, aged 5. In both the authors admitted carious teeth, and they were unwilling to state positively that there were no previous foci in other parts of the body which had healed. Stanton had a case (*Am. Med.*, 1906, xi, No. 2, 401) in a male, aged 53, where the kidney lesion was the only one apparent, but he found at the autopsy a small scar-like area in the colon with peritoneal adhesions around it, and thought that this was the primary focus, as no others were found in the body at autopsy.

The changes in the kidney in the early stages of the disease are those of miliary formation where the colonies are beginning to grow. The cortex is usually first attacked. These small areas are usually pale yellow in color and their edges have the appearance of palisade-like rows of clubbed bodies. As the colony grows it excites inflammation with round-cell infiltration; softening results, and, if there are colonies in the vicinity, coalescence occurs; finally, an abscess is formed, floating about in the pus of which are the loosened col-

FIG. 398.—ACTINOMYCOSIS OF THE KIDNEY. In the drawing to the left note the foci in the cortex and medulla, more numerous in latter. Each focus shows one or several ray fungi. The largest focus shows central breaking down. Note also tissue reaction around foci. The tubules in the cortex are choked and have practically disappeared, while the glomeruli are dilated. The capsule is thickened. The small square in the first figure is shown 80 times magnified in the second picture above to the right, where the inflammatory infiltration and tubular degeneration are more clearly brought out. The middle picture below shows a ray fungus 500 times magnified, with inflammatory change about it, consisting of polymorphonuclear leukocytes and small round cells. The lower picture to the right, also 500 times magnified, demonstrates the atrophy and obliteration of the tubules of the medulla and the great increase in inter-tubular interstitial fibrous tissue. The small squares in the upper figure to the right indicate the areas shown enlarged below. (MacD. From Bender Laboratory, Albany, N. Y.)

onies, which form the characteristic yellow granules. The tendency is not toward the formation of one abscess of large size, but rather toward the formation of many small abscesses. The kidney changes around the abscess cavities are in the nature of granulation tissue, with a tendency to proliferation; hyalin degeneration is seen in places, and there are also atrophy and cicatricial formation (Fig. 398). The result is a tissue of considerable density. If the pelvis of the kidney is reached by the gradual progressive softening of the abscesses, the pus finds an outlet and is discharged with the urine. When the disease attacks the kidney by continuity, adhesions are formed between the affected organ and the kidney, and the usual changes in the kidney result. Of the secondary degenerations which may attack the kidney, amyloid is the most common.

Symptoms.—A patient affected with actinomycosis of the kidney, this being the seat of the sole or at any rate the principal lesion, suffers from the symptoms characteristic of a suppurative nephritis. If the symptoms are severe, and there is general systemic disturbance, we may suspect secondary infection with another germ, severe pyelonephritis, with general septicemia, resulting. In Israel's case the patient, an army officer, had a sudden attack of hematuria after exposure to cold; with this there was a dull, heavy pain in the kidney region. After several weeks of intermittent bleeding there remained sensitiveness under the ribs, which was worse on exertion. Pyuria soon appeared, and the patient began to lose health. This condition lasted a year, and then there was a recurrence of symptoms, with fever and chills and pain in the abdomen. After three years of suffering a number of small lumps appeared in the lumbar region at the site of a previous nephrotomy wound, and when these were incised, pus was discharged; in this pus the characteristic granules were discovered, and on examination of the urine similar granules were found in the sediment. The patient was cured by nephrectomy.

The clinical appearance of an actinomycosis infection closely resembles that of tuberculosis in that there may be high afternoon temperatures, followed the next morning by an afebrile condition. When secondary infection is not present this temperature is accompanied by a leukopenia.

In cases in which there is general systemic infection the patient suffers from fever, chills, great prostration, sweating, and, toward the end, delirium, with drowsiness and other symptoms of severe pyelonephritis. When the disease is secondary to actinomycosis in other parts of the body the kidney symptoms are generally overshadowed by those of the primary affection and, in most cases, the lesion is apparent only at autopsy.

Diagnosis.—Most reliance may be placed upon the urinary findings. The

discovery of the microörganism in the urine is conclusive evidence of the disease in some part of the urinary tract. Involvements of the kidney may be suspected if there is pain under the ribs, but even if this is present, one must bear in mind the possibility of the disease affecting other organs in the vicinity.

Treatment.—If the kidney is the only organ involved, a nephrectomy will effect a cure; but if other organs are affected, especially internal organs, the chances of cure are very slight indeed. Duvau ("Thèse de Lyon," 1902, 100), in a list of 255 cases of actinomycosis affecting the various parts of the body, estimates the mortality in the thoracic form at 85 per cent., and in the abdominal form at 65 per cent. In these serious cases, with secondary involvement, palliation is all that can be accomplished. The administration of iodid of potassium was at one time thought to do good, but experience has shown that it is not very valuable; arsenic may be used in conjunction with it. The iodid should be given in large doses, as much as six grams daily if the patient will stand it.

CHYLURIA.

The name chyluria applies to a symptom, namely, the presence of chyle in the urine. It is a condition of rare occurrence in temperate climates, but is very common in tropical and subtropical regions. It is due, for the most part, to the parasite *Filaria sanguinis hominis*, although found occasionally independent of this disease.

The *Filaria* is a parasite discovered in 1863 by Demarquay, and thoroughly studied by Manson. The adult worm, which measures about 38 mm., lives in the thoracic duct and lymph passages of the human being. The embryos, which are about .2 mm. long, appear in the circulating blood during the attacks of chyluria. They are taken up from human beings by mosquitoes and after passing through one cycle of their existence in the alimentary tract of the mosquito, they reënter the human being by the intestines.

The disease is endemic in Brazil, Egypt, India, and Japan.

The presence of the chyle in the urine is generally preceded by certain prodromal symptoms. It may come on as the result of exposure to the cold. Often there is pain in the kidneys, which radiates to the testicles, and there is generally nausea and vomiting. Usually the urine is a little red at first, and then becomes the color of chyle. The presence of chyle may be noted at night in some cases, in others, only in the day. The general health may be good for quite a while. If the urine passes into a glass, it separates into three layers, a creamy upper layer, a lower layer of little clots, and a middle layer looking like milk. This clotting

sometimes occurs in the bladder itself. The embryos of the parasites are often found in the urine. The chyle results from a dilatation of all the lymph vessels, due to plugging of them by the parasite.

Diagnosis.—The diagnosis is made by examination of the urine. The parasites may be found in the blood, and there is also a marked eosinophilia. The prognosis becomes grave only when the amount of lymph lost is very great.

Treatment.—During the attack the patient ought to be in a bed with his foot elevated. Methylene blue was formerly employed. Atoxyl has given occasional improvement. Recently encouraging reports have been made from the salvarsan treatment. Manson advises light diet and mild purging.

CHAPTER XXIII.

PYELITIS.

PYELITIS IN GENERAL.

Pyelitis, strictly considered, is an inflammation of the mucous membrane of the pelvis and calices of the kidney, in contradistinction to pyelonephritis, which means an infection of both the pelvis and the parenchyma of the kidney, and is frequently associated with ureteritis, as well as with cystitis. This strict pathological definition has no real clinical value. Whether such a localized condition ever occurs is doubtful. The use of the word dates from the time of Rayer, and has so grown into the literature in a purely clinical significance that in describing the milder and non-surgical forms of pyelonephritis it seems best to employ the usual term. Strictly speaking, all infections of the kidney, from the simplest to the gravest, represent different stages of the same condition and should be treated under one heading.

Portals of Entry.—Pyelitis, with the exception of the cases due to chemical irritants, which are not considered here, is always due to bacteria. In most cases these reach the kidney through the blood stream. As already pointed out in Chapter VIII, in order to produce inflammation there must be some added source of lowered resistance in the kidney. Bacteria can pass through the kidney out of the blood into the urine in great numbers and for a long time without exciting inflammation. Infection of the kidney by means of the lymphatics is possible but extremely rare. Infection by ascension up the ureter is also possible but exceptional, occurring only in cases presenting marked changes in the vesical orifices of the ureters due to prolonged cystitis. Such cases do occur in the ordinary infections and particularly in tuberculous infections. In a perfectly normal bladder there is no reflux of urine from the bladder to the kidney, which has been ascribed to the oblique direction of the ureter in the bladder wall, but is not entirely due to this, as it is quite possible to show that there is no reflux when the ureter is implanted by operation directly into the bladder.

Etiology.—In Chapter VIII is given in detail the bacterial fauna of the

urinary tract. In chronic cases the colon bacillus is usually found in pure culture, while in acute ones the staphylococcus, the streptococcus, and the proteus bacillus are more frequent. The infection is usually single, but may be multiple, from the etiological standpoint. Many of the streptococcus and typhoid bacillus infections finally yield to the colon bacillus. Among unusual organisms are the gonococcus, the pneumococcus, and the bacillus of grippe. One of the earliest cases of gonococcus infection was described by one of us (Kelly, "Operative Gynecology," 1894, i, 524). Since this early case a number of others have been reported, and cases have been described by a number of foreign authors (Tédenat, *Ann. d. mal. d. org. génito-urin.*, 1907, xxv, 1215). One of the last, reported by an American, is that of Dr. Louis C. Lehr (*Trans. Amer. Urolog. Assn.*, 1912, vi, 236).

Among contributory causes to bacterial inflammation in the kidney are stone, hydronephrosis, pressure on the ureter from without, retention of urine in the bladder, general infection, local infection in other parts of the body, cystitis, etc.

Pathology.—The pathology of pyelitis is most beautifully shown in the atlas of Rayer, now more than 70 years old. As might be expected, the location and intensity of the lesions vary greatly. It has been customary to describe that form in which the lesion is mainly in the kidney as a descending infection, and that with marked pelvic and ureteral involvement as ascending. Such a description, while still allowable, should not be taken as evidence of the portal of entry of infection, this being almost invariably, as already said, the blood.

If the flow of urine from the kidney into the bladder has been interfered with on one side, as in the case of the pregnant uterus, or on both sides, as in prostatic hypertrophy, the result is to render the involved kidneys peculiarly liable to infection. This occurs through the blood. If such a case comes to autopsy one finds a fairly normal looking kidney, but marked disease of the pelvis and ureter. Clinical studies demonstrate beautifully, however, that such kidneys are far from normal: in many cases the secretory power is reduced almost to nil. Where a kidney has yielded to a violent infection without any retention weakening being superadded, the picture may be quite different. Here, in the acute stages, the kidney is large, and abscesses may be present in the cortex; in the chronic stages patches of inflammatory tissue represent these abscesses. The capsule is thickened and the whole kidney may be shrunken up, yet, with these marked changes in the kidney parenchyma, the ureter and the pelvis may appear practically normal. The cases, however, are not divided into two such clear-cut groups. Few, indeed, are typical, for every stage of transition between the two exists.

Symptoms.—In a disease with such variety of location and marked variation in intensity, there is also a great variation of symptoms. These may be general, due to the absorption of toxins, or failure to eliminate waste products; or they may be localized in the kidney; or, finally, they may be confined to manifestations of disturbance in the function of the bladder. Uremic manifestations are common enough with cases of bilateral pyelitis, and are typically presented in old prostatic sufferers. In such patients there is loss of appetite; thirst; loss of weight and strength; nausea; mental torpidity in the early stages, and, in the later ones, death from coma, often with typical uremic convulsion. In simple pyelitis this condition is rarely seen, even in very old and advanced cases. Temperature is always present in the acute cases, and may or may not be present in the chronic ones. No type of fever is characteristic of pyelitis, for there may be continuous elevation of temperature in some; remittent temperature in others; and typically intermittent temperature in still other cases. The degree of temperature does not depend on the severity of the case, and is not proportional to the pus and infecting organisms found in the urine. We recall one patient who, following labor some six months before, began having intermittent attacks of chill followed by fever reaching 104° . This condition greatly distressed the physician, who had acted as accoucheur, and was attributed by him to some obscure pelvic infection, but it proved to be an infection of the left kidney of such a mild character that only scant pus and colon bacilli were present. At first it was difficult to believe the kidney condition anything but secondary to some other focus in the body. Nevertheless, on hexamethylenamin and water this patient cleared up at once and permanently, leaving little doubt of the diagnosis.

The fevers which occur in little children are discussed in a separate section. Fully as interesting as these fevers are the apyretic cases where the urine is loaded with pus and organisms and the general condition goes uninfluenced for months and even years.

As a rule, pain or other symptoms referable to the kidney are rarely found. Now and then, however, the patient will complain of dragging pains and, occasionally, of a distinct renal colic.

The development of bladder symptoms is the rule, and, in many cases the cystitis so dominates the field that it is the only thing complained of. Some authors have laid particular emphasis upon the frequency of micturition at night, insisting that simple bladder inflammation without involvement of the kidney will show much less frequency at night than during the day. It is our impression that all cases of genuine pyelitis are associated with frequency of voiding, whether there is or is not definite involvement of the bladder. This

frequent emptying of the bladder is, in part, due to its irritability, and in part to the fact that most cases of pyelitis of the chronic variety are associated with large quantities of urine.

Diagnosis.—The diagnosis of pyelitis rests on a careful examination of the urine, and, finally, on examination of the urological tract by catheterization of the ureters and separate studies of the kidneys, as described in Chapter IX.

In acute pyelitis the urine contains a surplus of albumin, some red blood cells, pus cells, and the bacteria which are causing the inflammation. In the chronic stages red blood cells may be absent. It is, however, a matter of considerable interest for the clinician to know that a pyuria of kidney origin is almost always, if not invariably, associated with a considerable amount of serum albumin. On the other hand, many pyurias are of vesical origin and show no serum albumin. There are exceptions both ways. In addition to obtaining the catheterized urine, it is always an advantage to test the total renal function. As a rule, the kidneys are not enlarged and are not tender on palpation. In chronic cases the vesical ends of the ureter are very likely to be thickened, just as they are in tuberculosis of the kidney, and pressure upon the ureter, by vaginal examination in the female or by rectal examination in the male, is almost invariably followed by pain and an intense desire to empty the bladder. These two symptoms, in combination with the cord-like feel of the ureter, are very characteristic.

The cystoscopic picture may disclose almost any degree of cystitis or, as is often the case, lesions in the bladder around the ureteral orifice of the affected side. Here one may see a reddened, pouting orifice, or a retracted golf-hole opening. If the pyuria is intense turbid urine can be seen on one side and clear on the other, and, if indigo-carmin is used, the differences may be most marked. The function of the kidney and the urine content and character are determined by catheterization of the ureter as described elsewhere in this book. Many cases of chronic pyelitis are associated with strictures of the ureter, and such demand special consideration and treatment. The diagnosis of stricture of the ureter is given in Chapter XXX. Here, we repeat briefly that every obstruction of the ureter "met in introducing a catheter" must not be regarded as a stricture, but must be thoroughly examined by functional test, by X-ray collargol injection, and by various catheters.

In addition to the urinary analysis a careful general examination should always be made. Many cases of pyelitis may be but secondary to other foci of infection. This is particularly true of the gonococcus cases. In the female one should always note the condition of the cervix and particularly of the Fallopian tubes. Many conditions of abscess in the body are associated

with pus and organisms in the urine, which readily heal when the primary cause is removed.

It is important to recognize that, while some pyelitides associated with fever are characterized by an increase in the absolute number of white blood cells and a relative increase of the polymorphonuclear leukocytes, with a decrease in the eosinophiles in the blood count, there are many exceptions. Many patients presenting high fever, with few or no local symptoms, except the pyuria, will show a perfectly normal blood count. We have seen this in a case of left-sided pyelitis in pregnancy, with the temperature 104° , and intense pain in the affected organ. When there are no local symptoms, such cases are frequently confused with malaria, tuberculosis, or typhoid fever, depending on the type of the pyrexia.

Prognosis.—The prognosis of pyelitis depends on its extent and its stage. Acute cases usually heal rapidly under appropriate treatment. On the other hand, long-continued infections are most difficult and often impossible to clear up.

Treatment.—In acute cases, rest in bed, abundant water, and urinary antiseptics, particularly the formalin liberators, are most important. In chronic cases, the same treatment, with the addition of lavage of the kidney through an ureteral catheter, vaccine therapy, nephrotomy, and drainage, with the removal of any cause for the condition, such as stone, hydronephrosis, stricture of the ureter, external pressure on the ureter, etc.

As already stated under Diagnosis, it is most important to be sure in a case of pyelitis that there is no primary focus of infection elsewhere in the body and no local conditions of the kidney rendering it vulnerable to bacterial attack. In every case, therefore, such conditions must be looked for and removed as a part of the treatment of the pyelitis itself.

We have found abundant water drinking of great value in all cases.

URINARY ANTISEPTICS.—Of the various urinary antiseptics, none compare with those which liberate formalin. The type of this group of drugs is hexamethylenamin, introduced many years ago into medicine by Nicolaier. It has come into very general use. One of us (Burnam) reported at the meeting of the American Urological Association (1912, vi, 286) a series of studies with it. We believe that in many cases there is no liberation of formalin in the urine after taking urotropin by mouth. A simple test for it is the addition of from one to three drops of .5 per cent. aqueous solution of phenolhydrogenhydro-chlorid and the same amount of a 5 per cent. aqueous solution of sodium nitro-prussid, with an excess of the saturated solution of sodium hydroxid. The presence of formalin is indicated, when abundant, by a deep blue; when

FIG. 399.—SIMULTANEOUS LAVAGE OF PELVES OF BOTH KIDNEYS. The renal catheters, marked by in-pointing arrows, must be introduced all the way up into the pelves and should be of such small size that a free reflux is possible around them into the bladder. An ordinary glass catheter, marked by the outgoing arrow, allows the irrigation fluid to escape from bladder. The funnels holding the irrigation fluid should be of ample size and held at the desired elevation (a little distance above the level of the body) by a nurse, or by some convenient apparatus.

very dilute by a green color. This color is transient. The freeing of formalin from urotropin is invariable in very acid urines. It occurs at the level of the kidney. It may occur in a urine which reacts alkaline to litmus and phenolphthalein. It is often absent in alkaline and moderately acid urine. The liberation can be increased by increasing the dose of urotropin. The ordinary dose of 5 gr. three times a day can be increased to 20 or 30 gr. three times a day. The liberation is also increased, as we have found in recent experiments, by giving acid sodium phosphate in combination with the urotropin. Casper and Citron (*Ztsch. f. Urol.*, 1911, v, 241) describe marked liberation of formalin from $7\frac{1}{2}$ gr. doses of myrimalid, which is a combination of hexamethylenamin and sodium acetate. We are confident that the good effects of all formalin combinations are due to the liberation of free formalin, and that a very good estimate can be put on the drug by the test described.

We have recently been employing a 1 per cent. alcoholic solution of phloroglucin as a test for formalin. It is very delicate, showing formaldehyd in dilutions as great as one to one million at body temperature. The test is carried out by adding one or two drops to the suspected fluid and then making it very alkaline with a saturated aqueous solution of sodium hydroxid. The presence of formaldehyd is evidenced by the gradual development of a pink color. The color of the urine markedly interferes with this color, so that in testing it is always necessary to dilute. For quantitative work it is of value to dilute down to the end point of the reaction.

LAVAGE OF THE KIDNEY.—If, after a thorough treatment of this kind there is no clearing up of the condition, the next step is to use lavage of the kidney. This method, well illustrated in Figure 399, has been used for many years since its description by one of us (Kelly) in the treatment of pyelitis. It yields very splendid results in many cases, and has been favorably reported upon by almost every urologist in the world. It is important to select a suitable medium for irrigating after catheterizing the ureter, and silver nitrate, in strength up to 1 per cent., has been much used, often yielding excellent results. It has, however, the disadvantage of being precipitated in the urine, so that it is never quite certain what quantity is active. All of the organic silver salts are of value; bichlorid of mercury solution, 1 to 10,000, can be used, and we have had some excellent results with solutions of formalin, beginning with 1 to 3,000 and working down to 1 to 1,000. The toleration for formalin varies very greatly.

Autogenous Vaccines.—Personal experience with autogenous vaccines has not been very encouraging, and we have not succeeded in curing any of the

chronic cases which have resisted other forms of treatment by their use. The technique of both small and large dosage was used.

Michaëlis (*Folia Serologica*, 1911, vii, Hft. 1) reports favorable results, also Bremerman (*J. Amer. Med. Assoc.*, 1911, lvi, 1843). In the *Zeitschrift f. Urologie*, Beiheft, 1912, are given experiences of Reiter, Rovsing, and others, of a most favorable character. H. H. Cabot (*Medical Record*, New York, 1910, lxxviii, 600) found distinct improvement of the symptoms, but no influence on the bacteriuria, while J. T. Geraghty (*Medical Record*, New York, 1910, lxxviii, 600) reported no improvement in 14 cases.

We have seen no ill results from the treatment and, therefore, in spite of our own failures, do not feel justified in saying that the method is without value.

SURGICAL PROCEDURE.—Surgical procedure is invariably necessary when there is some anatomical condition rendering the affected kidney or kidneys liable to infection. The pressure of a uterine fibroid upon the ureter which contains infection is an indication to remove the fibroid. Infection with stone kidney has already been dealt with. Stricture of the ureter will indefinitely postpone the healing of a kidney infection and demand treatment. In many cases the ureters must be cut across and implanted into the bladder to secure the drainage necessary for healing the kidney. A full account of this is given under Strictures of the Ureter, Chapter XXIX.

We have not been particularly favorably impressed with nephrotomy for chronic pyelitis. In a number of cases where it was done, relief only resulted while the incision was open; in no case have we seen a cure, and there is the possibility that a procedure of this kind is destructive to the already weakened kidney parenchyma. Therefore, let it be resorted to only in those cases which give a great deal of trouble and have resisted every other form of treatment. Nephrectomy is rarely, though occasionally, indicated in cases where a pyelitis on one side remains as the heritage of a previous pyelonephritis by which the kidney's function is greatly impaired. In such cases a kidney which no longer acts for the body becomes a source of infection and constant irritation of the bladder. Cases of chronic cystitis due to such kidneys only yield when freed from their damaging influence.

Pyelitis in children and in pregnant women presents so many unique features as to demand separate consideration.

PYELITIS IN CHILDREN.

Occurrence.—These cases are seldom seen, even by those who deal most extensively with kidney infections. Escherich and Holt in the same year (1894) reported cases for the first time, pointing out the existence of the disease, while to Finkelstein is due the credit of emphasizing the frequency of the trouble. In recent years a large literature has grown up on the subject. Among the contributors in this country have been I. A. Abt (*J. Am. M. Assoc.*, 1907, xlix, 1972) and Edgar B. Friedenwald (*Arch. Pediat.*, 1910, xxvii, 801). The disease may occur almost from the first day of life. In Friedenwald's 80 cases one child was only 11 days old, and his oldest case was 22 months. It is not only common in infants, however; it is also frequent in childhood. Many of the early observers noted the condition only in females. Göppert (*Berl. klin. Wchnschr.*, 1909, xlii, 639) found 89 per cent. in females, but Friedenwald in his series observed that 27½ per cent. were males, showing both sexes to be frequently affected.

Etiology.—The disease is most frequently a complication of some infection elsewhere or some severe nutritional disturbance. The colon bacillus is the organism commonly found, though other pyogenic organisms occur occasionally. Dr. George Waugh, of the Great Ormond Street Hospital, London, communicated personally that he had observed persistent bacteriuria in children which would not yield to the ordinary treatment or, if it did, recurred shortly afterward, but was permanently relieved by removal of the appendix. This would seem strong evidence that many of the cases have their origin in conditions of the intestine which permit the absorption of bacteria.

There seems but little question that most of the infections in childhood, as in older periods, are through the blood. Just why females are more often affected would not seem to be explained by a short urethra and ascending infection, although many of the cases do show the combination of cystitis and pyelitis. Even in early childhood a condition of stone or hydronephrosis may be the determining cause of infection. There are no available data to indicate that one kidney is usually infected. It is quite probable that these infections are frequently unilateral. Dr. William M. Jeffreys (*Quart. J. Med.*, London, 1910-11, iv, 267) found that in 30 cases 15 were unilateral and 12 of the 15 were right-sided.

Symptoms.—The condition may be either chronic or acute, while the symptom-complex varies immensely. In the acute case the onset may be very sud-

den. The child becomes restless, pale, feverish, and rapidly loses weight and strength. The temperature chart shows great variation, presenting almost every type of fever. Some cases are very mild, presenting no constitutional symptoms but merely frequency of micturition with pain. On the other hand, there are the cases which are quickly fatal, with high temperature and much general prostration. Some are greatly prolonged and most obstinate in their resistance to all treatment.

Diagnosis.—Diagnosis rests on a careful history and a thorough urinary examination. The presence of pus and bacteria in the urine is almost invariable, sometimes accompanied by marked albuminuria and casts. Wherever, as in a hospital, the X-ray is convenient, pictures of the kidneys and bladder should be taken. In older children, where the condition is chronic, and ordinary treatment fails to relieve, there should always be a comprehensive urological examination.

Treatment.—If the condition is due to stone, or infected hydronephrosis, treatment is indicated exactly as in the adult; such patients respond readily to appropriate surgical procedure. In view of the importance of intestinal origin great care should be taken to do away with all stasis and inflammation of the bowel, while, in obstinately recurring cases, attention should be given to the findings of Dr. Waugh.

Local treatment of the bladder is not valuable, but, on the other hand, urotropin and its allied compounds are. Urotropin can safely be given in 1 gr. doses several times a day; its increase being guided by testing carefully for the liberation of formaldehyd in the urine.

PYELITIS OF PREGNANCY AND THE PUERPERIUM.

Pyelitis is a very frequent accompaniment of pregnancy and the puerperal period. The diagnostic errors to which it has led have been numerous, and, until quite recently, its importance has not been fully and generally appreciated in this country. Réblaub (*Congrès franç. de chirurg., Proc. verb.*, Paris, vi, 692) opened up this question by describing quite accurately several cases. A number of other French writers followed him. One of the most complete reviews is that by Opitz (*Ztschr. f. Geburtsh. u. Gyn.*, 1905, lv, 209). Among French contributors should be especially mentioned Legueu, Cathala, and Bar; among German, Barth (*Dtsch. Ztschr. f. Chir.*, 1906, lxxxv, 57) and Mirabeau (*Arch. f. Gyn.*, 1907, lxxxii, 485). At the meeting of the American Medical Association (1912), a valuable contribution was made to this subject

by Dr. Edward P. Davis, of Philadelphia (*J. Amer. Med. Assoc.*, 1912, lix, 859).

A pre-existing pyelitis or pyelonephritis is made much worse by a pregnancy. Such cases, however, should be clinically separated from those which arise during the pregnancy and because of it.

Etiology.—The colon bacillus is usually the infecting organism and generally in pure culture. There are, however, cases on record where other pus-forming organisms are present, either alone or in association with the colon bacillus. The condition may develop at any period of pregnancy or after labor, in the puerperium. It is usually a unilateral infection and principally found on the right side. Bilateral infections, however, are common enough, and we have seen several limited to the left kidney. Many theories have been advanced to explain the frequency on the right side, such as pressure of the pregnant uterus on the ureter, pressure of the head of the child, congestion and swelling of the mucous membrane of the bladder closing of the ureteral orifice. It seems quite likely that it is a mechanical hindrance to the flow of the urine on the right side, plus an unusual absorption of colon bacilli from the bowel, which leads to this infection.

Symptoms.—Here, as might be expected, the clinical picture varies immensely with the extent and severity of the infection. Some cases present no symptoms, the condition being revealed by urinalysis. In others there is only marked general disturbance, as shown by elevation of temperature and loss of appetite, with consequent nutritional disturbance. The type of the fever is most variable. It may be a typical typhoid curve running at an even high level, or it may be, and frequently is, markedly remittent, associated with chill and sweat. When the condition occurs after labor, it is invariably thought to be a puerperal infection. In quite a number of cases there is marked pain in the kidney region, and this may be intense, as we have observed in a number of cases. Frequent voiding, with pain, is common, but not often distressing. Its existence is more often brought out by careful history-taking than by voluntary statement by the patient.

Diagnosis.—The diagnosis rests on a careful urological examination in every suspected case. With fever alone, it is necessary to exclude tuberculosis and typhoid fever, but when pain is present also, appendicitis and inflammation of the gall bladder may be suspected. In the puerperal period the condition must be carefully distinguished from ordinary puerperal fever. We have frequently relieved an anxious doctor, seen in consultation, by the almost magic effect of giving hexamethylenamin.

Sippel (*Centralbl. f. Gyn.*, 1905, xxix, 1121) describes a perirenal abscess

following a pyelonephritis of pregnancy. After delivery, most of the acute symptoms general, as well as local, disappear. Some cases heal without treatment, but, if not properly treated, many pass into a chronic condition; some spontaneously abort.

Treatment.—Pyelitis in association with pregnancy should be regarded as a serious complication and receive prompt, energetic, and complete treatment. Regulation of the bowels and abundant water consumption are always indicated. Hexamethylenamin is well borne and should be given in full doses. If the condition persists, and especially if pregnancy is advanced to a period where a viable child is possible, great amelioration and sometimes relief of the condition may be reached by catheterization of the ureter and irrigation of the kidney pelvis. In the early months of pregnancy such cases as resist these measures should be promptly treated by bringing on a miscarriage. The persistence of a kidney infection for months nearly always means irreparable damage to the affected organ if nothing worse. In the later months the procedure to follow is that of nephrotomy, which has been especially advocated by Barth (*loc. cit.*) and by Dr. Edward P. Davis (*loc. cit.*), both authors reporting a number of favorable cases. Sometimes the fistula closes before delivery, in other cases it persists until the child is born and then closes. There is no tendency to interruption of the pregnancy; most of the constitutional symptoms disappear, and the kidneys, when cleared of infection, are not impaired. In determining upon this operation, let there be careful consideration not only of the obstetrical but also of the urological features. In these later cases interruption of pregnancy is a serious procedure and more difficult and dangerous than nephrotomy.

As shown by a number of cases—for example, report of Cova (*Annali di ostet. e ginec.*, 1903, xxv, 692) and the discussion of Dr. E. P. Davis' paper (*J. Am. Med. Assoc.*, 1912, lix, 859)—it is possible to do a nephrectomy without interrupting the pregnancy or killing the patient. A nephrectomy, however, is an extreme measure and probably never necessary.

CHAPTER XXIV.

PYELONEPHRITIS, PYONEPHROSIS, MULTIPLE ABSCESES AND INFECTED INFARCTS OF KIDNEY, PERIRENAL INFLAMMATIONS.

Pyelonephritis is a term applied to inflammatory processes in the kidney parenchyma. It is usually associated with pyelitis. Multiple abscesses and infected infarcts are really an early stage of pyelonephritis, constituting conditions in which, in certain of the acute stages, the symptoms may be so distinct as to require separate classification. **Pyonephrosis** is a term applied to those cases in which there is an accumulation of pus in the kidney pelvis or parenchyma. **Perirenal inflammation** is a term applied to inflammatory processes in the fatty capsule of the kidneys and in the retroperitoneal fat. It may or may not be associated with involvement of the kidney itself. It may lead to the formation of immense abscesses. The direction which these may take in the fascial planes is well shown in Figures 40 and 41.

INFLAMMATION OF THE KIDNEY PELVIS OR PARENCHYMA.

ETIOLOGY.

It is quite impossible to draw hard and sharp lines between the various conditions of the kidney due to infection. Very many acute pyelitis cases are probably also pyelonephritic. The same factors which occur in pyelitis are of importance in the causation of those more serious conditions. Pyonephrosis is always associated with some obstruction to the outflow of urine, as pointed out under Pyelitis. The obstruction may be in the lower urinary tract, or in the ureter, and is often at the ureteral pelvic junction. Pyonephrosis may develop from a pyelonephritis or a pyelitis in a kidney previously healthy. Such a condition is usually, and properly, termed a primary pyonephrosis; it may develop in a hydronephrotic kidney where the pelvis has already been dilated but infection has not taken place.

Experience has led more and more to the belief that most of the kidney and

ureteral infections are blood infections. Countless experiments on animals have shown that it is very easy to produce kidney infections by injecting pus-forming organisms into the blood, and that the probability of infection is greatly increased by any influence tending to lower the vitality of the kidney. This has been shown experimentally by obstructing the ureter in animals, and is shown clinically in countless cases where ureteral obstruction has followed some pathological process within its own wall or is caused by pressure from contiguous tissues.

It has been contended that movable kidney favors the infection. We have not been personally impressed with it as an etiological factor. On the other hand, in 99 cases of stone in the kidney, infection was found in no less than 72. In 70 cases of kidney tuberculosis, there was an associated colon bacillus infection 12 times. Animal experimentation likewise, as a rule, speaks against the ascending infection. This is more clearly shown in the case of the tubercle bacillus than any other organism, as clearly demonstrated by Durand-Fardel, Baumgarten, and Walker. Its occurrence after cystitis does not in itself preclude the infection coming from the blood.

All the organisms which cause pyelitis may lead to the severer lesions. Definite kidney abscesses due to the gonococcus have been reported by Tédénat (*Ann. de mal. d. org. génito-urin.*, 1907, xxv, 1215) and Le Fur (*Assoc. franç. d. urol.*, 1904, Sess. viii, *Proc. verb.*, 753). Dr. William Nixon, recently of the Johns Hopkins Hospital, has communicated personally two cases and collected a number of definite cases from the literature. The typhoid bacillus is undoubtedly a more benign organism than most of the others. In some cases the colon bacillus has a tendency to create mild disturbances but in others very marked ones. On the other hand, quite mild conditions may be associated with staphylococcus and streptococcus infections. No sharp lines, we believe, can be drawn between these organisms as regards either the gravity of prognosis or the indications for treatment.

PATHOLOGICAL ANATOMY.

A description of the lesions which can occur is a difficult matter, because there are variations all the way from congestion of the kidney, with a few small abscesses, to complete destruction and enormous distention in some of the pyonephrotic cases. It has become the custom to describe a pyelonephritis as of descending or blood origin or of ureteral or ascending origin. This classification was formerly used in reference to tuberculous kidneys, which we now know are all blood infections.

In acute septic nephritis the kidney is increased in volume, shows congestion, and often presents upon its surface areas of hemorrhage or little abscesses. This is well shown in Figure 400. On section these areas are found extending down to the medulla, often, as in the case noted, in the form of

FIG. 400.—MULTIPLE INFECTED INFARCTS OF KIDNEY. The left-hand drawing shows the characteristic grouped nodular whitish areas, often surrounded with a deeply injected zone. The section on the right shows how these zones extend wedge-like into the deeper parts, each also surrounded with an inflammatory area. (H. G., Ch. H. and Inf., Jan. 5, 1910.)

infarcts. Microscopic examination may show the vessels of the glomeruli packed with organisms. In a little later stage, in place of the hemorrhagic zones, there appear definite abscesses. There may be no lesions whatever of the pelvis, though generally there is distinct pyelitis. In the so-called ascending form the lesions of the kidney may be simply those of sclerosis or there may be abscesses, situated principally in the medulla and spreading out toward

the cortex. The ureter and pelvis always show marked inflammatory changes. In both forms there is fibrous inflammatory reaction about the kidney in its fatty capsule, and sometimes purulent inflammatory reaction.

As already stated, pyonephrosis is an inflammatory condition of the kidney in which there is a distention of its pelvis with pus. In the pyonephroses which develop from pyelonephritis it is often difficult to determine just what should be called the initial condition, though certainly any pelvis which holds over 30 c. c. should be so classified. In cases of infected hydronephrosis the amount of pus and the distention of the pelvis may be enormous, often amounting to two or three liters. The form of distention varies with the amount of kidney destruction and the amount of distention of the pelvis. Where the lesion is principally limited to the latter, extensive sclerosis in the kidney parenchyma, usually more marked than in hydronephrosis, is often found. In cases of double ureter there may be a pyelonephrosis or pyonephritis of only half the kidney. In one of our cases, Mrs. P., there was a pyonephrosis of the lower poles of both kidneys associated with calculi.

The ureter, in many cases, presents great thickening with inflammatory reaction about it. This is always true in those cases associated with obstructions in its course, and is especially to be noted in the case of stone.

SYMPTOMS.

The symptoms of a disease presenting so many pathological conditions and dependent on so many primary causes are necessarily varied. In acute pyelonephritis there may at the beginning be nothing but high fever and signs of a severe intoxication. The degree of the fever and the intoxication, however, show great variation. Every stage from that of a mild acute pyelitis symptom-group up to that of sudden and violent septicemia and uremia may be seen. G. E. Brewer (*Surg., Gyn., and Obst.*, 1906, ii, 485) has called attention to a severe type, accompanied by high fever, going to 104° and over, rapid pulse, reaching 130, marked signs of intoxication, usually tenderness over the kidney affected, and generally slight traces of blood, pus, and albumin in the urine. This condition is associated with multiple septic infarcts of the kidney, such as are shown in Figure 400. Brewer, contrary to most observers, regards this condition as unilateral. He has observed prompt recovery from one-sided nephrectomy in a number of cases. Sometimes there is severe pain in the side affected, usually in the form of colic.

The characteristic symptoms of pyonephrosis are pus in the urine, pain in the side, tumor in the side, and fever. The pus may be present in

large amounts. If the ureter of the side affected becomes closed during a period when all the other symptoms are most pronounced, the urine may be clear. This condition is known as intermittent pyuria. Pain may be entirely absent. It is often present only during acute exacerbations of the condition. Tumor is always present when a pyonephrosis reaches large size. It is remarkable, however, especially in deep-chested men, how difficult it may be to diagnose increased size, even with large accumulation. Fever is a very variable symptom and, with an opened and old pyonephrosis, may be absent for months. During exacerbations it may become very high and be associated with marked septic manifestations of an acute pyelonephritis.

The fever is usually of the septic type, going up in the afternoon and falling to normal in the morning. There are frequent chills and sweats. With many cases of pyonephrosis the worst subjective symptoms are those associated with the bladder, the constant downpour of pus leading to severe and intractable cystitis.

It is remarkable how the general health of these patients, in some cases, is unimpaired for years. Most of the old cases are colon bacillus infections, and this may account for the condition. Patients may have large pyonephrotic kidneys and show no fever, nor disturbance of general health under long periods of observation, even when there are frequent exacerbations. On the other hand, many patients fail rapidly in health and soon present evidence of metastasis in other parts of the body. Rheumatisms are common, while definite joint infections often occur.

DIAGNOSIS.

Pyelonephritis.—The diagnosis of acute septic pyelonephritis is often very difficult. This is especially true in the cases associated with septicemia due to severe infections elsewhere. There may be no renal or vesical symptoms and the urine may be normal. The appearance of small amounts of blood, pus, and casts in the urine is suggestive, and this is especially true if there is any tenderness in either kidney. The urine is usually scanty. If the disease is markedly double-sided there are almost sure to be uremic developments. With a known infection in some other part of the body, the sudden onset of pronounced symptoms of sepsis should be very suggestive. Some of the most violent cases come on suddenly, without any warning and without any demonstrable trouble elsewhere in the body. This was the case in the patient, H. G., C. H. and I., age 14, shown in Figure 400. The infecting organism was a streptococcus, and the fever suggested typhoid. The blood examination in these

cases invariably shows a high leukocytosis, from twenty to thirty thousand, and the polymorphonuclear cells may reach 90 per cent., or higher. The employment of indigo-carmin or phenolsulphonephthalein might assist in such a case, and certainly, if applicable, a catheterization of the ureters and separation of the urines from the two sides would aid in diagnosis, though usually the patients are so ill that such procedures have not been carried out. In the more chronic cases, when once the abscesses have opened into the pelvis, and especially when cystitis has developed, the diagnosis becomes comparatively simple, catheterization of the ureters readily showing the true condition.

Pyonephrosis.—The diagnosis of pyonephrosis is made on the clinical symptoms, but, above all, by careful urological examination and catheterization of the ureters. Often the diagnosis is made by the cystoscopic examination alone, when the pus is seen coming down one ureter. This is particularly striking where chromocystoscopic methods are employed. A closed pyonephrosis is readily determined by this procedure.

By a cystoscopic examination the condition of the bladder is determined. The separate catheterization of the ureters and collection of the urine will yield the following facts: First, whether one or both kidneys are involved in the inflammatory process (frequently a pyonephrosis is seen on one side and a pyelitis on the other); second, the character of the organism, which is ascertained by cultural and staining methods. It is always of the highest importance to exclude tuberculosis, which must be thought of in every case. Third, the actual secretory power of the two kidneys, determined by functional test methods. It should be constantly borne in mind that the function of a pyonephrotic kidney may greatly improve under proper treatment. It is not wise to draw absolute conclusions from such a test even when carried out for hours. It can show that the healthy, or relatively healthy, kidney is capable of carrying on the entire function, but it can not give positive evidence as to the possibilities of the diseased kidney. This is well shown in the case of Mrs. A., in which there was a pyonephrosis of colon origin, due to an impacted ureteral stone. In this case we found a dilated ureter, the dilatation extending to the pelvic brim, where the stone was caught in a close stricture. The kidney had been catheterized, and the catheter left in for seven hours continuously. A nephrectomy was carried out on account of the condition of the ureter. On macroscopic and microscopic examination there appeared to be a great deal of normal, functioning parenchyma in this kidney. The functional tests also show that it is not the amount of pus nor the distention of the pelvis which always determines the amount of kidney destruction. One

occasionally meets large pyonephroses doing good work. The actual capacity of the pyonephrosis can in some cases be measured by injecting the distended kidney and measuring the amount injected and the amount recovered, as shown in Chapters IX and XVII. It is always well in these cases to be sure that the catheter is actually in the pelvis. We had the unpleasant experience in one case of distending the kidney and then not succeeding in getting a back-flow, due to valve-like closure at the ureteral pelvic junction, and it is conceivable that this might lead to very disagreeable symptoms. The ureteral catheter, if waxed, will often show the presence of stones in the ureter or pelvis.

An unusual complication, met with by Dr. Hugh Young, is illustrated in Figure 323, and recently we had a like experience in the case of Mrs. P. This patient presented a mass in the right side. The urine from the bladder contained pus and colon bacilli. Cystoscopic examination showed a normal bladder. Both ureters were catheterized and normal urine obtained from each side. The patient had given a history of pain in both kidneys extending over a period of several years, and was brought into the hospital for an acute appendicitis. X-ray pictures and skiagraphs showed large stones in both kidneys. Operation demonstrated the presence of an acutely inflamed appendix, which was removed; it also showed stones and pyonephrosis in the lower half of double kidneys present on both sides. The lower pelves were opened, the pus emptied, the stones removed, and the patient recovered. The right kidney was done at the same sitting as the appendix, the left kidney three weeks later. In this case there were only two ureteral orifices in the bladder, and the pus could have been obtained from both kidneys if the catheters had been introduced only a few cm. up the ureter. The presence of the two ureters and the double pelvis would doubtless have shown in a collargol injection, carried out in the way described by Voelcker and Lichtenberg. We have had an identical experience in the case of bilateral tuberculosis of the kidney. The bladder urine contained pus, but the bladder was not inflamed, and the urine from the kidneys was normal.

X-ray pictures are, of course, essential in all cases of kidney infection, and should include both kidneys and both ureters. It is not uncommon, where the main symptoms are those of pyonephrosis, to find a stone in the other kidney.

As already noted, even large pyonephroses may not be palpable on bimanual examination. Careful percussion of the back and marking out of the areas of dulness of the two sides are of great value in some cases and show clearly the enlarged kidney on the side of the pyonephrosis.

TREATMENT.

In considering the treatment of the graver infected processes of the kidneys many factors must be borne in mind. Such questions as: is the infection one-sided or bilateral, is the total renal capacity sufficient, is the diseased side still capable of function, is the disease primarily or essentially renal, must be answered. The treatment of acute pyelonephritis is essentially a different subject from that of the treatment of old pyelonephritis and pyonephrosis, so that these questions are best taken separately.

Acute Pyelonephritis.—In acute pyelonephritis of the milder types the symptoms and the treatment, so far as medical measures are concerned, correspond to those of pyelitis. In every case, if there is a primary focus of infection elsewhere in the body, this must be located and treated. If there is any obstruction of the lower urinary tract, this must be removed. Even when there is no obstruction, the use of the retention catheter is of great advantage. It can be introduced and left in for days. The patient should always be put to bed, kept on a milk or a very light diet, given large amounts of water, and urotropin or helmitol in doses up to 100 gr. a day for the adult, and about 8 gr. for infants. In those cases which tend to drag on, an autogenous vaccine should be made and employed. It is of advantage in some cases to supplement the water taken by mouth by salt infusions.

The surgical treatment of acute pyelonephritis has, up to the present time, been very limited. It should be restricted to the severest types of infection. Surgeons have been deterred from operative procedures in these cases by the conviction that the disease is bilateral. K. G. Lennander (*Nordiskt. Med. Arkiv.*, 1901, xxxiv, 1) reported several cases in which he secured recoveries by opening the kidney, removing abscess-foci, resecting badly diseased portions, and draining the kidney. Schede, quoted by Kümmell and Graff (*"Handbuch der Praktischen Chirurgie,"* Bergmann u. Bruns, 3rd ed., 1907, iv, 212), has twice successfully resected the kidney without doing a nephrotomy. Wilms (*Münschen. med. Wchnschr.*, 1902, xlix, 476) has likewise reported successful cases and advises that the method be limited to one-sided cases. G. E. Brewer (*N. Y. Med. J.*, 1906, lxxxiv, 361) divides the cases into three types: severe with high temperature and marked toxemia, requiring nephrectomy; mild, in which the initial temperature may be high but begins to fall within 48 hours, and in which the treatment is decapsulation of the kidney and opening of any small abscesses on its surface; mild cases which can be treated medicinally. Five cases of the severe type in which he did a nephrotomy all died. Eight cases of the severe type, where one-sided

nephrectomy was carried out, all recovered. Decapsulation and drainage in 5 patients of the milder type resulted in recovery. Several of Brewer's cases are most interesting and instructive. In one case a patient had been presenting symptoms for 11 days before coming to his attention. This patient died, the only operation performed having been an exploratory incision down the kidney. Autopsy revealed multiple septic infarcts of the right kidney and no sign of infection elsewhere in the body. The clinical course of several of his successful nephrectomies indicated that the disease was one-sided. Brewer is especially urgent that in severe cases the sooner the operation is done the better the result. Autopsy reports on these cases have almost invariably shown the disease to be bilateral. In several cases which have come under our observation, where the symptoms have been most fulminant and death resulted in a few days, this has been the condition.

It is of interest that most of these cases of Brewer presented no apparent primary focus outside the kidney. This was the case with one of our patients, H. G., age 13, Jan. 5, 1910. The patient, a young girl, without any apparent cause, began running a high and continuous fever. The temperature ran from $102\frac{1}{2}^{\circ}$ to $104\frac{1}{2}^{\circ}$. Her physician, Dr. Louis Hamman, first suspected typhoid, but the blood showed a leukocytosis of over 20,000, and the urine a few pus and a few red blood cells. There were no other symptoms except an appearance of intoxication and slight tenderness over the right kidney. Percussion of the back indicated enlargement of this kidney. The operation was done at 6.30 P. M. A lumbar incision was made down to the right kidney, which was found adherent to its fatty capsule. It was about twice the normal size, showed definite and multiple hemorrhagic areas, and nephrotomy disclosed the fact that these were present throughout the kidney in the form of infarcts. The condition seemed so serious that nephrectomy was carried out. The infecting organism in this case was a pure streptococcus. The kidney, as it appeared after removal, is shown in Figure 400. The temperature by midnight had fallen to normal and the pulse to 88. The temperature continued to fall, and the patient markedly improved. The temperature in the afternoon, however, would go to $99\frac{1}{2}^{\circ}$ or 100° , and on the 18th day after operation it suddenly shot to 104° and the pulse to 130. The patient looked ill and was very toxic. For three days the temperature ran from 104° to 105° . The first day of its elevation was marked by a reduction in the urine output to 800 c. c. On the next day it rose to 2,000 c. c. Five days after the onset it dropped down, but the patient continued to have some fever until the 26th day after operation. She was discharged on the 37th day after operation with still a little pus in the urine but otherwise well; 50 days after the

operation the urine was entirely normal, and the patient has been well for more than a year. We have quoted this case in detail because it illustrates the fact that, even with severe symptoms, in involvement of the solitary kidney improvement can follow medical measures. In this case a milk diet, infusions, large amounts of water by mouth, and 10 gr. of urotropin every 4 hours were given. In view of this recovery we were impressed with the fact that the patient might have recovered without the nephrectomy. Dr. Brewer's fatal case, in which death occurred from the involvement of a single kidney, the other being healthy, showed the other side of the question. His results from nephrotomy stand in contrast to those of Lennander and Wilms. This may have depended in part upon double-sided involvement in his cases.

In several cases where we have done a preliminary nephrotomy, a nephrectomy has subsequently been necessary. An excellent result was obtained in another case of multiple abscesses of the kidney by nephrectomy. The patient, Mrs. S. F., May 16, 1907, had had symptoms and signs of cystitis for a year. On March 13 a vesicovaginal fistula was made. This was allowed to drain and the patient was perfectly well until April 14th, when she suddenly began to run a temperature of 101° to 103°, and suffered severely with pains in the right kidney region. On April 17 a few pus cells and the colon bacillus were obtained from the right kidney. Her condition grew worse and on the 19th, in addition to severe pain, a mass was felt in the right side. The right kidney was catheterized and abundance of perfectly clear urine obtained. Unfortunately no estimation of the function in comparison with the other kidney was made. The diagnosis of perirenal abscess led to exploratory incision in the back. No perirenal abscess was present, but the kidney was enlarged, presented many pin-point abscesses on its surface, and on section was found riddled with abscesses. A nephrectomy was carried out, the temperature dropped to normal, and the patient made an uninterrupted recovery. This case again emphasizes the fact that the ordinary urinary findings may be very misleading as to the condition of the kidney.

From the above considerations it is evident that the question of the treatment of the severer cases of this group is a very difficult one. Prompt, efficient medical measures, as indicated here and under Pyelitis, must be carried out. The diagnosis should always be fortified by separate catheterization of the ureters and the employment of the functional tests. Recourse to operation must depend on the surgeon's judgment and, when possible, nephrectomy should be avoided. This subject deserves more study and careful recording of cases. Dr. Brewer is apparently the only surgeon who has carried out many nephrectomies for this condition.

Chronic Pyelonephritis.—In chronic pyelonephritis the conditions are practically similar to those in chronic pyelitis. At the very beginning of the consideration of the treatment it is essential to determine whether the condition is unilateral or bilateral and, if unilateral, what is the relative functional capacity of the other kidney. The medicinal measures outlined for chronic pyelitis should be carried out, if the kidney presents sufficient functional capacity to justify it, and also if the patient is in good general health and not suffering from the condition. If the disease is one-sided and the patient suffering from it, either in general health, in an intractable cystitis, or in rheumatic manifestations, the treatment should be nephrectomy. Many otherwise incurable cystitis cases are thus promptly relieved and the integrity of the healthy kidney secured.

In one patient, operated on more than a year ago, at the Cambridge Hospital, Maryland, great relief from chronic rheumatism followed the removal of an old colon bacillus infected left kidney, which still showed considerable functional capacity. The right kidney in this case was healthy. The mere presence of pus, however, from a kidney is not in itself an indication for operation. It should be borne in mind that a chronic pyelonephritis may persist for years with practically no local or general disturbances.

Pyonephrosis.—While chronic pyelonephritis, provided the ureteral drainage is free, is a disease on the border line between medicine and surgery, pyonephrosis is preëminently a surgical condition. Little can be hoped for by ordinary medicinal treatment. Although rarely curative, marked benefit and, under certain conditions, great prolongation of life may follow judicious treatment through a renal catheter. Operative procedures can be divided into two groups from the standpoint of their aims: *conservative*, which attempt to cure the disease and preserve the kidney; *radical*, which cure the disease by removing the affected organ.

Various considerations are influential in determining whether to attempt to save the kidney. First, the condition of the opposite kidney is a matter of prime importance. If it is healthy, the diseased kidney can be safely removed. Next in importance is the condition of the diseased kidney. An early, acute pyonephrosis may be associated with very little kidney destruction, and, consequently, with little impairment of its function. Where the function is entirely or almost destroyed the operation of choice is nephrectomy. Under certain conditions it may be impossible to undertake so radical a procedure. This is the case with patients extremely ill, and with very large pyonephroses, when a preliminary drainage of the kidney may be followed by a secondary nephrectomy. With both kidneys involved and both secreting, a

nephrectomy should never be done. Often the most difficult cases to decide in regard to this point are those in which one kidney is healthy and the other still capable of good function. Conservative measures always mean longer

FIG. 401.—PYONEPHROTOMY. FIRST STEP IN EXPOSURE AND EVACUATION OF PUS KIDNEY.
Note posture of patient on bag, the length and position of the incision and the aspirator, which holds 500 c. c. The smaller drawing above shows the relation of the pus to the kidney and the relation of the kidney to the surrounding structures. Note the small stone plugging the opening of the ureter into the pelvis which is the cause of the pyonephrosis. After emptying the pus, a wide opening is made into the collapsed kidney.

illness, less likelihood of absolute cure, and not infrequently must be followed by nephrectomy.

CONSERVATIVE TREATMENT.—The most conservative treatment of pyonephrosis is evacuation of the pus through a renal catheter and irrigation of the pelvis. If the disease is unilateral and recent this treatment may greatly ameliorate, or even cure the condition, and it is thus possible, occasionally, to greatly prolong the life of a patient with a single pyonephrotic kidney. Often, too, a single emptying and washing out may relieve the symptoms for months.

Not every case of pyonephrosis can be emptied by a catheter, though it is always worth trying, even in cases where it is determined ultimately to operate, because the patient's general condition may be improved and the field rendered more sterile.

The conservative operation has a twofold aim: first, relief of the obstruc-

b
f
•

FIG. 402.—PYONEPHROTOMY. SECOND STEP IN ENUCLEATION OF A LARGE PYONEPHROTIC KIDNEY. The pus having been evacuated, the finger introduced into the pus cavity readily pushes through the friable kidney substance, but is checked on reaching the strong, thickened fibrous capsule. The finger then sweeps between the capsule and parenchyma, as indicated by arrows, until the kidney is entirely free within its capsule down to the hilum, and is peeled out, much like an orange detached from its skin, down to the pole at its stem. The detachment is usually more easily carried out in this way than by beginning the separation at the point of original puncture for aspiration. This intracapsular enucleation obviates a difficult dissection of the kidney outside its capsule, which often detaches it at great risk from an adherent bowel, besides saving much time, and minimizing the dangers of infection following the complete nephrectomy. Calculi, when present, should be delivered at this step of the operation.

tion which is causing retention; and, second, cure of the infection. In cases of mild infection of hydronephrotic sacs it is occasionally possible to do one of the plastic operations described in Chapter XVII. It is usually wise as a preliminary procedure to do a nephrotomy, and attempt a cure of the infection. Occasionally it is of advantage to combine a nephrotomy and plastic operation.

When the obstruction is due to stone in the ureter, this can be removed. Here, too, if there is a large pyonephrosis, it is always best to do a nephrotomy. In cases where there is stricture of the lower end of the ureter an extravesical implantation of the ureter may be carried out, an operation we have successfully performed in several cases. The procedure is shown in Figures 443 and 444.

FIG. 403.—PYONEPHROTOMY. THIRD STEP IN INTRACAPSULAR ENUCLEATION. The kidney, liberated on all sides down to its vascular pedicle, is grasped by strong forceps, as shown, close to the kidney in order to secure as long a stump as possible for ligation. The clamp should be smooth-edged, it should give an even pressure, and it must not slip.

The chief conservative operation is nephrotomy. This is usually a simple operation, which means little shock to the patient and no interference with the kidney function. As a rule, a lumbar incision is the best. In very large pyonephroses this may be lateral, or even ventral, and still be extraperitoneal. The operation should always be carried on outside the peritoneum. After exposing the kidney, as shown in Figure 401, it is of advantage to draw off the

pus in a large syringe. This prevents extensive soiling of the field of operation. A drainage tube is inserted into the kidney through an opening made by plunging a blunt clamp into it. The opening of a large pyonephrosis is practically always bloodless, and no attempt should be made to determine the line of vascular cleavage as in an ordinary nephrotomy. When the kidney is not greatly

FIG. 404.—PYONEPHROTOMY. FOURTH STEP IN INTRACAPSULAR ENUCLEATION. The kidney is removed with as much of the thickened capsule as can safely be resected. By means of an aneurysm or round needle threaded with stout catgut, the vessels are ligated below the forceps, which is then removed. The cavity is packed with iodoform gauze drains, and brought out through the lumbar incision, which is closed down to a small opening at the lower end.

distended and can be readily reached, the landmarks should be sought after and the opening made in a vascular zone. If there is an obstruction of the ureter and the kidney is still capable of secreting, this operation is invariably followed by a permanent fistula in the side. Albarran first emphasized the fact that many of these fistulae would close if a ureteral catheter was introduced at the time of operation and permanently kept in place. In many cases the nephrotomy, relieving the pressure and clearing up the inflammation, also serves to do away with the obstruction. Küster, in 100 nephrotomies, noted 27 cures. In some cases where the kidney is completely destroyed and functionless there follows prompt healing without fistula or sinus. On the other hand, in certain cases where the pyonephrosis is combined with abscesses in the cor-

tex, the symptoms may not be greatly relieved. It is often necessary in cases of multiple pockets to open several times. It certainly would be of advantage in many cases of pyonephrosis to do an early nephrotomy in the hope of saving the kidney. This is an especially important procedure when the patient has but one kidney.

RADICAL TREATMENT.—The radical treatment consists in removal of the diseased kidney. The indications for this operation have already been outlined. According to Küster, quoted by Wagner (*"Handbuch der Urologie,"* Frisch u. Zuckerkandl, ii, p. 196), in 143 patients treated by lumbar nephrectomy there was a death rate of 16.7 per cent., and in 7 patients treated by transperitoneal nephrectomy, a death rate of 57.14 per cent. In 100 nephrotomies there was a death rate of 17 per cent. These figures mean very little. To begin with, nephrotomy is usually carried out in desperate cases, and where the disease is frequently bilateral. In unilateral pyonephrosis the death rate of nephrotomy should be almost nothing, and certainly the death rate from nephrectomy is very small.

The operation of choice in most cases is the intercapsular method, which can be carried out almost as quickly and safely as nephrotomy. This method is shown in Figures 402, 403, and 404. Intracapsular nephrectomy can be carried out perfectly safely after a primary nephrotomy. This method of primary nephrotomy and secondary nephrectomy, when necessary, is gaining ground every day, and is the operation of choice.

PERIRENAL INFLAMMATIONS.

ETIOLOGY.

Perirenal inflammations may follow inflammatory processes of the kidney, or develop primarily in the perirenal tissue, or have their origin in the inflammatory processes from some other organ. The arrangement of the perirenal and pararenal fats (Figs. 40 and 41) indicates how abscesses may spread from very distant sources. Heinrich Stromberg (*Folia Urologica*, Leipzig, 1910, iv, 533) has gone into this question from the historical as well as the experimental standpoint with great care. He notes that the classical monograph of Gerota only deals with the question of the fascia immediately around the kidney. Limited space does not permit of a thorough review of this work, but the reader can grasp the possibilities of the extensions which can take place by carefully studying Figure 39. It is not an uncommon finding to see a perirenal abscess originating from the appendix. Almost every surgeon has noted

such. Küster, in 230 cases of perirenal abscess, has noted that 3 had their origin in the appendix. Cases on record have originated in abscesses of the liver and the gall passages, also in perforating ulcers of the intestines, stomach, and pancreas. Tuberculous abscesses from the ribs and vertebræ are not uncommon. Occasionally, an empyema breaks through the diaphragm and leads to a perirenal inflammation. By far the commonest source, however, is the kidney itself. R. Guiteras (*N. Y. Med. J.*, 1906, lxxxiii, 169-178) furnishes some statistics in regard to the source of perirenal inflammations.

The primary perirenal abscesses develop as the result of trauma and infection of a hematoma. In some cases the suppuration does not develop until long after the trauma. Abscesses are not uncommon in the course of various infectious diseases, notably typhoid, scarlet fever, and smallpox. Many cases arise from puerperal infections. W. Albrecht (*Beitr. z. klin. Chir.*, 1906, 1, 147) has furnished an interesting contribution, showing that perirenal abscesses may develop from purulent infections of the lower urinary tract. The involvement is not from the kidney, but by metastasis through the blood.

According to Küster, the common age of occurrence is middle life, males are more commonly affected than females, the right kidney region oftener than the left. His study is to be found in the report of Woshimasu (*Inaug. Diss.*, Greifswald, 1905). That cases do occur in children, however, is shown by Townsend's report (*J. Am. Med. Ass.*, 1904, xliii, 1626) and in that of G. R. Curran (*Saint Paul Med. J.*, 1905, vii, 645).

PATHOLOGICAL ANATOMY.

Since the original descriptions of Rayer it has been customary to describe perirenal inflammations as sclerotic, fibrosclerotic, and suppurative. The latter particularly concern us in this connection. It has been pointed out in the chapters on stone kidney, tuberculosis of the kidney, and pyonephrosis how common it is with such conditions to have the perirenal fat disappear as such and become transformed into a dense fibrous tissue, adherent to all the surrounding organs. Often this tissue takes on a hyalin, almost cartilaginous appearance. With this type of perirenal inflammation intracapsular nephrectomy must be carried out.

Often in old stone or tuberculous kidneys the kidney itself is largely replaced by a fatty fibrous tissue which may preserve fairly well the original kidney outline. Cases are on record where operators have examined both kidneys through an abdominal incision and found one enlarged and seemingly

diseased, while the other appeared normal. On the basis of this palpation they have removed the enlarged kidney, only to find it an organ which had undergone compensatory hypertrophy, while the supposedly healthy kidney was a functionless body of fat. This condition is shown in Figure 314.

In perirenal abscesses the abscess cavity is usually unilocular; yet occasionally there are many pockets. The common location in reference to the kidney is behind it, so that the organ constitutes the anterior face of the abscess. Such an abscess is likely to point either in the superior lumbar triangle or in Petit's triangle. Occasionally the abscess is in front of the kidney. Such a case is reported by H. Mallins (*Lancet*, 1901, ii, 913), where the abscess ruptured into the peritoneal cavity. Much more frequently these abscesses rupture into the intestines. As shown in Figure 39, abscesses which develop below the kidney easily descend into the iliac fossa or the ischiorectal fossa, and may point in Scarpa's triangle, underneath Poupart's ligament. It is not an uncommon occurrence for an abscess to develop upward, become a sub-diaphragmatic abscess and break into the pleural cavity. It is fortunate that most of them are behind the kidney, for this location tends to the least number of complications and is most readily accessible to treatment.

SYMPTOMS.

The symptoms of perirenal abscess vary greatly in their onset and course; usually they are very insidious and at first present but few symptoms; occasionally, however, the onset is sudden, with marked pain and tenderness in the side, high fever, signs of general infection, etc. In acute cases infection at its outset manifests itself, as a rule, by high continuous fever. In the more chronic cases the fever may be remittent, and is often intermittent, the rise being in the afternoon. In very chronic cases large abscesses are occasionally found in which there is no elevation of temperature whatever.

The pain is also a variable factor. It may be severe and paroxysmal, radiating from the loin across the body down the leg, or even occasionally up toward the shoulder. Often the pain is simply of a dull, aching character, and in some cases, of the chronic variety, it is practically absent.

In early acute stages there may be no enlargement in the side, but sooner or later tumefaction is pretty sure to set in. In a thin subject swelling is usually readily detected by inspection and palpation. In stout people, with thick abdominal walls, it is sometimes quite difficult to determine. As a rule, no definite outline is determinable on palpation, there being only a general sense of resistance. Careful percussion of the suspected side and comparison

with the opposite side is a valuable procedure. The areas of dullness in cases of perirenal abscess, especially those located on the posterior surface of the kidney, are greatly increased. Occasionally there may be reddening and swelling of the skin. In the acute conditions there is always a marked leukocytosis and a relative increase in the polymorphonuclear neutrophilic elements. As a result of the intoxications and the fever there are often marked secondary anemias. Frequently there is great disturbance of the gastro-intestinal system. Unless there is renal trouble accompanying the perirenal abscess, the urine may be perfectly normal and there may be no symptoms pointing to the urinary organs.

DIAGNOSIS.

In the very early stages, when there may be no symptoms except fever and evidence of infection, the diagnosis is most difficult. In such cases the entire body has to be gone over, and it is rare indeed that the focus of the trouble is located. When pain is present a valuable pointer is obtained. In cases where pain is present with very little fever, the differentiation from neuralgia, lumbago, and spinal nerve lesion may be quite difficult. In every case the kidney should be catheterized and its urine carefully studied chemically and microscopically; a comparative estimate of its functional activity and that of the other side should also be made. As already pointed out, it is not uncommon in pyelonephritis, when the infection does not communicate with the pelvis of the kidney, to find urine which contains no pathological elements. In such a case it would be of great value to know the functional value of the kidney in comparison with its fellow. If the two kidneys are found functioning equally, it is improbable that the disease is associated with lesions of the kidney. On the other hand, a marked difference points strongly to associated renal trouble. The presence of fever and the absence of leukocytosis with other symptoms of perirenal abscess point to a tuberculous infection. The actual giving of tuberculin by the ophthalmic method in such cases further fortifies diagnosis.

PROGNOSIS.

If promptly submitted to treatment the prognosis is usually very good. It depends, of course, on the complications and the patient's condition. When not properly treated, some of the acute cases may result in rapid death from severe septicemia, but this is exceptional. In most acute cases a large abscess will form within two weeks, and is likely to point and often to rupture in one of the directions pointed out. In some cases the development may be

very slow and extend over many weeks or even months. Spontaneous cures occur with great frequency when the abscess ruptures in Petit's or Scarpa's triangle. Rupture into the intestines and pelvis of the kidney is much less favorable. Rupture into the pleural cavity through the diaphragm is usually fatal, but a certain number of cases are on record which have spontaneously healed. Rupture into the peritoneal cavity usually means death.

TREATMENT.

The treatment for perirenal abscess is surgical. It should be opened and drained as soon as diagnosed. The proper incision is in the lumbar region, through the superior lumbar triangle, as shown in Figure 173. When the abscesses are very large, or situated at the lower pole of the kidney, the incision may be lower and more anterior, as shown in Figure 183. The treatment of the kidney will depend on what the preliminary examinations have shown as to its condition. If it is functionless, it is often wise to do an intracapsular nephrectomy at the same time as the drainage of the perirenal abscess. Let it be remembered in every case of perirenal abscess that the condition in fully one-half of the cases is secondary to disease in other organs, and it is of the highest importance to bear in mind the treatment of the primary condition. If the organ primarily affected is the kidney, the rules in regard to treating it are those laid down in connection with the various diseases of this organ.

CHAPTER XXV.

NEW GROWTHS OF THE KIDNEY, URETER, PERIRENAL TISSUES, AND ADRENAL GLANDS.

TUMORS OF THE KIDNEY AND URETER.

The knowledge that the kidney is the site of malignant growths dates back to the very beginning of medicine. There is a vast literature bearing on the subject, although it is only within comparatively recent times that it has begun to be comprehensively studied. Among the contributions of great value should be mentioned the studies of Albarran, Israel, the Mayos, Garceau, and the works emanating from the associates of these men.

These tumors are rare. According to Küster's general statistics only 23 cases were observed in a series of 30,000 patients. Many busy general surgeons may go for an entire year or more without seeing a single case. Up to July, 1912, there had been but 83 in the Mayo Clinic at Rochester, Minn. (W. F. Braasch, *J. Am. Med. Ass.*, 1913, lx, 274). Garceau ("Tumors of the Kidney," 1909) found only 90 cases in 3,592 autopsies performed at the Massachusetts General Hospital and Boston City Hospital.

These growths can be classified as benign and malignant, and subdivided as growths of the renal parenchyma and of the pelvis. The benign growths of the renal parenchyma are adenoma, angioma, lipoma, and fibroma; and of the renal pelvis, lipoma and papilloma. The malignant growths of the parenchyma are carcinoma, sarcoma, adenoma, and hypernephroma; those of the pelvis, papilloma, epithelioma, sarcoma, and carcinoma. In addition to these primary tumors, with which we will deal here alone, there are many secondary growths due to metastasis or extension from other organs.

BENIGN TUMORS OF THE RENAL PARENCHYMA.

These growths are rare and surgically unimportant. They are usually discovered accidentally at autopsy. The lipomata are almost invariably very

small, although Kelymack ("Renal Growths," London, 1898, 64) mentions one growth of this type which attained the size of a child's head.

Angiomata, invariably small, are mostly situated immediately below the kidney capsule. Fibromata occasionally attain large size, as in the case reported by R. Bruntzel (*Berl. klin. Wchnschr.*, 1882, xix, 745). The tumor in this case weighed 20 pounds and occasioned severe hematuria. The tumors when small practically never give symptoms; when large, they give pressure symptoms and occasionally the other manifestations characteristic of renal growths. The treatment, when they are recognized, is surgical, as it is only by operation that they can be distinguished from the much commoner malignant growths.

BENIGN TUMORS OF THE RENAL PELVIS.

These growths are extremely rare, with the exception of the papillomata, which will be described in detail under Malignant Tumors of the Bladder, because they show all the peculiarities of similar growths in the bladder, especially those connected with the rapid transformation of parts of the growth into malignancy. Small mesodermal tumors, particularly angiomata, are not uncommon. A. Croisier (*Congrès français de chirurgie*, Paris, 1907, xx, 1009) reports finding a lipoma in a woman of 33. It was of moderate size and removed by operation. Unless they grow to large size or cause hematuria, these growths usually entirely escape observation in life. When they present these symptoms, or any others characteristic of renal tumor, the indication is prompt and radical operation. The chances of any tumor of the kidney being benign are too small to warrant considering a postponement of operation.

MALIGNANT TUMORS OF THE RENAL PARENCHYMA.

It is extremely difficult to go through the immense literature which has been written about malignant tumors of the kidney and to gather a clear conception of the clinical findings and course of the different pathologic types of growth now known to us. The hypernephromata and the embryonic tumors are the best known, as they are the most frequent. In addition to these carcinomata and sarcomata are definitely recognized, subdivided into round-celled, spindle-celled, fibro- and lipo-sarcoma. There is also a semi-malignant type of adeno-carcinoma, which has been given the name of malignant adenoma. We do not propose to do more here than briefly outline the generally accepted facts as to the occurrence, structure, and course of these growths, and to give in more detail the same criteria for hypernephroma and embryonic tumors.

Occurrence.—In adult life the hypernephromata are by far the most frequent tumors of the kidneys; in childhood the embryomata. Some idea as to the actual frequency can be obtained by reading the report of Louis B. Wilson (*Ann. Surg.*, 1913, lvii, 534), who found that in 92 tumors studied at St. Mary's Hospital, Rochester, Minn., 71 were hypernephromata, or, as he prefers to call them, mesotheliomata; 3 embryomata, 1 Wolffian tumor, 7 sarcomata, 1 adenoma, 1 fibroma, 3 papillomata of renal pelvis, 4 carcinomata of renal pelvis, 1 squamous-celled epithelioma. In a group of 126 cases of malignant tumor, secured in the clinic of James Israel, Arthur Bloch (*Folia Urologica*, 1909, iv, 161) reports that 86 were hypernephromata, 6 sarcomata,

6 papillomata of the kidney pelvis, 4 carcinomata, 5 embryomata, 6 papillary cysts, and 1 teratoma. Edgar Garceau ("Tumors of the Kidney," 1909), in 90 specimens secured from the Massachusetts General and Boston City Hospitals, makes the following classification: benign hypernephroma of the adrenal gland, 1; malignant hypernephroma of the adrenal gland, 3; perirenal sarcoma, 1; papilloma of the renal pelvis, 1; hypernephroma of the renal parenchyma, 45; carcinoma of the renal parenchyma, 3; papillary cyst-adenoma of

FIG. 405.—CARCINOMA OF THE KIDNEY. Primary carcinoma of the kidney in which both cortex and medulla are shown. Patulous ducts are seen opening at the papilla. The carcinoma tends to spread in the boundary zone between the medulla and the cortex. The small square is shown magnified in the next figure. (Path. Lab., Boston City Hosp., No. So. 5901.)

the renal parenchyma, 15; sarcoma of the renal parenchyma, 2; fibroma, small, 14; lipoma, small, 5.

Malignant disease of the kidney is found especially in the extremes of

life, in childhood, and after forty years of age. Excluding cases in children, and the oldest of whom was 6 years old, in 30 cases taken from our own and the surgical records at the Johns Hopkins Hospital, only one patient was under 40 years of age. This was a young man of 19, who died without operation from a very malignant hypernephroma.

Renal Carcinoma.—The first author who definitely demonstrated a cancer developing from the adult renal epithelium was Waldeyer (*Arch. f. path. Anat. u. Phys.*, Virchow, 1867, xli, 493). The gross appearance is not characteristic. Starting in the parenchyma, the disease rapidly advances toward both the capsule and the pelvis. It is disseminated by the lymphatics and blood vessels, just as in hypernephroma; thrombi may extend through the vena renalis into the vena cava. The growth rarely attains large size, as metastasis is early. Strikingly characteristic in the microscopic structure is the arrangement of the cells in masses without definite form. Occasionally, the cells are found arranged in columns and cords, suggesting the tubular arrangement of the normal kidney. Sometimes an alveolar type of arrangement is seen, giving rise to the so-called alveolar carcinoma. The individual cells often show irregular karyokinesis, but are not particularly cancer-like. The diagnosis on the slide rests more upon the general arrangement than upon the structure of the individual cell. The gross appearance of a tumor of this class is well shown in Figure 405. The microscopic appearances, with various degrees of magnification, are given in the diagram in Figures 406 and 407. The symptoms and treatment of this type of malignant growth are so similar to those of sarcoma, hypernephroma, and embryoma, that we shall treat them all under one head, which follows shortly.

Renal Sarcoma.—Sarcoma of the kidney is more common than carcinoma; it rarely attains great size, it is not infrequently bilateral, and usually begins in the capsule, but sometimes deep in the parenchyma. It may be either the round-celled or spindle-celled type; occasionally the cells are stretched out into distinct fibers, making the so-called fibro-sarcoma. The tumors are usually soft and, on section, present a gray, uneven appearance. The general microscopic appearances of the tumor are well shown in Figure 408.

Adenoma of the Kidney.—Adenoma, as already stated, may be either benign or malignant. The benign form, which is the commoner, is usually very small, and gives no symptoms whatsoever. It is especially common in chronic interstitial nephritic kidneys and usually occurs after forty years of life. It may be single or multiple, it varies in size from a pea to a small orange, and is usually attached to the capsule. On section, it is soft, frequently showing spots of hemorrhage, and is usually a grayish-red color. It may be solid or

FIG. 406.—CARCINOMA OF THE KIDNEY. The central picture shows that part of the tumor indicated by the square in the last figure, magnified 100 times. The cancer cells are packed together in a solid nodule, without any tendency to alveolar arrangement. Around the nodule is some round-cell infiltration. Beyond it are a number of well preserved glomeruli and tubules; and some isolated cancer foci, shown in the small squares magnified above. Note the details of the enlarged cancer cells. In the middle drawing there is a mitosis of a cancer cell in a capillary. The two figures below give an idea of the cellular arrangement of the typical cancer areas.

FIG. 407.—CARCINOMA OF THE KIDNEY. The figure above shows a section including cortex and medulla 8 times magnified. There are many separate foci of varying size in the cortex and the medulla. The cortical cancer areas have a tendency to occur in groups of glomeruli, the intervening tubular structures likewise being involved. This type of distribution differs from that shown in Fig. 406; there the cancer spreads out like a crab, while here it seems to jump from point to point, with subsequent fusion of small foci into nodules of larger size. This corresponds to the advance of cancer in many other organs. The square shown in the upper picture is 80 times magnified in the picture below and to the left. The part of this section included in the rectangular strip is pictured 300 times magnified to the right, showing the extremely irregular and wild appearance of the individual cancer cells.

FIG. 408.—SARCOMA OF KIDNEY. In upper figure to the left is shown the general arrangement of the cells as to distribution of tumor. The nodules show central necrosis. The cortex is thinned, but fairly normal. One of the capsular veins above under the capsule, shown in the small square, contains a metastasis. The arrow points to a drawing of the same 240 times magnified. The lower picture shows the square indicated in low magnification 80 times magnified. Note below and to the left the closely packed sarcoma cells, and to the right and above the compressed and inflamed parenchyma with flattened glomeruli. Between these two is a zone showing marked round-cell infiltration. The square in the midst of the sarcoma tissue, as indicated by arrow, is shown above, magnified 240 times. The character of the individual cells is shown in the magnification 600 times. Note the irregularity in shape of the cells and nuclei, as well as in size and staining; one cell shows normal mitotic division. (Pathological Laboratory, Boston City Hosp., No. So. 6250.)

FIG. 409.—TUBULAR ADENOMA OF THE KIDNEY. The upper picture to the left shows this specimen 8 times magnified. The adenoma occurs in nodules separated by dense bands of fibrous tissue. The small area shown in the square is 80 times magnified below. The tubules are irregular in size and have no definite arrangement except a persistent inclination to form end ampullæ, like the horns of a ram (a), which is found in the periphery of embryonic kidneys. (Fig. 78.) Some of the tubules are found in the connective tissue septa. The small figure to the right above shows the square indicated on the picture below, magnified 240 times. Note that the tubules correspond closely in structure to the normal collecting tubules. (Path. Lab., Mass. Gen. Hosp., No. 1093.)

FIG. 410.—PAPILLARY CYST-ADENOMA OF THE KIDNEY. Figure to the left and above shows a section of tumor 8 times magnified. It is made up of a framework of connective tissue, the main septa are rather thick, the secondary septa more delicate, and the tertiary quite fine. This connective tissue is lined by epithelial cells which show many finger-like projections into the cyst-like spaces. The structure of this growth closely resembles the well-known papillary cyst-adenoma of the ovary. The fluid filling all of these spaces still persists in the alveolus below to the left. The square appears in the lower figure 80 times magnified. The finger-like projection encased in the little frame to the right is shown above, 240 times magnified. Note the delicacy of the fibrous center, the formed blood vessels, and the epithelial cells covering the papillary structure. There is no definite arrangement in layers of the epithelial cells, although there is a tendency to be multiple. (Path. Lab., Mass. Gen. Hosp., No. 1521.)

cystic. There are three distinct types: (1) the tubular type, where the cells are arranged in tubules; (2) the alveolar type; and (3) the papillary type. It is especially this papillary tumor that is inclined to develop into large cystic growths. The microscopic appearances of the simple gland type of adenoma are shown in Figure 409, while the papillary cyst-adenoma is shown in Figure 410.

Before taking up hypernephroma it seems well to state that, with the exception of the adenomata, the other malignant tumors of the kidney present the

FIG. 411.—HYPERNEPHROMA. The tumor is split longitudinally. Note the small quantity of kidney tissue left at the lower pole, and the rupture of the tumor into the pelvis at the papillæ, as well as the tendency to form cysts. ($\frac{1}{2}$ natural size.) (From H. H. Young, Jan. 25, 1901.)

same symptoms as hypernephromata, but usually run a much shorter course. Especially malignant are the carcinomata and the round-celled sarcomata. General cachexia may be the first symptom. Tumor is not so important as in hypernephroma. Hematuria is common. According to Garceau, the average duration of the disease, after the onset of symptoms, is only a few months;

this was true in six of his patients. The diagnosis rests on a thorough urological and general examination. The data obtained by these examinations, in-

FIG. 412.—HYPERNEPHROMA. The tumor mass affecting the right kidney was removed through a wide T incision (Fig. 189). The convalescence was uninterrupted and the patient was living 3 years later. Above and to the right about one-half of the intact kidney is seen; in the renal pelvis there are two stones. From the lower calyx 3 tongues of tumor tissue closely packed together project into the pelvis, each representing the outflow of the tumor from diseased papillæ of the lower calices. The entire lower half of the kidney is replaced by the new growth, which is still confined within the true capsule of the kidney. In the principal tumor mass there are three distinct zones, an outer dark hemorrhagic, a middle pale necrotic, and an inner cystic. All parts of the growth present a honeycombed appearance. A nodule of new-growing tumor is shown which is advancing down the pyramid and will ultimately break into the calyx and then grow out into the pelvis. A plug of tumor is seen in the renal vein (b). (Mrs. M. G., age 52, July 6, 1907.)

cluding the valuable pyelographic pictures, do not differ essentially from those found with hypernephroma. It is impossible in an adult, before operation and

Hyp
nephroma

FIG. 413.—HYPERNEPHROMA. Enormous right hypernephroma, serving to demonstrate the great difficulties which may be encountered in a radical operation. The upper part of the kidney was fairly normal and the adrenal glands were perfectly normal. There was a small metastasis in the left kidney. The cecum and the ascending colon were intimately attached to the growth. The transverse colon was distended and tortuous, the duodenum was pushed downward and forward, and there were metastases into the iliac mesentery. The genital organs were uninvolved, except some anastomoses between the vessels of the mesosalpinx and the tumor. The ureter was not involved. The renal vein was free, but the ovarian vein had been invaded and filled by the tumor, which extended to the vena cava. (See following figure.) There were metastases to the pleura and inguinal glands. (Mrs. D., J. H. H., June 7, 1901. Autopsy.)

before pathologic examination, to distinguish the different types of malignant tumor. In general, large tumors speak for hypernephroma, as does also bone metastasis. The age of the patient is practically of no value. The prognosis

after operation has not been sufficiently founded on careful observations to justify a definite conclusion, though in general it may be stated that few of these patients survive more than a year after an operation, and many of them die within a few months.

FIG. 414.—CORONAL SECTION THROUGH TUMOR SHOWN IN LAST FIGURE. The honey-combed structure is characteristic of hypernephroma. In the formation of the tumor both poles have been spared and nearly all of the medulla. The growth, in place of extending into the pelvis and the renal veins, has broken through the capsule and extended peripherally. The normal adrenal gland is separated from the kidney by a layer of fat. $\frac{2}{3}$ natural size.

Hypernephroma.—The name hypernephroma we owe to Grawitz (*Arch. f. path. Anat. u. Phys.*, Virchow, 1883, xciii, 39) and to O. Lubarsch (*Ibid.*, 1894, cxxxv, 195). Until the time of Grawitz's description, the tumors, on account of their yellow appearance, had been described as lipomata. The conclusion of Grawitz was that these growths developed from small pieces of aberrant adrenal gland. Many pathologists have denied this origin, and the evidence to-day is perhaps less conclusive than ever before. The smaller

growths suggest in their appearance the cortex of the adrenal gland, and are mostly benign. The larger growths, which in places look exactly like the small ones, resemble much more the sarcomata and carcinomata. The smaller tumors occur most frequently in the upper pole of the kidney, but may occupy any part of it. They are rarely larger than a walnut, and are usually close to the

Anterior

FIG. 415.—MESIAL VIEW OF HYPERNEPHROMA OF RIGHT KIDNEY. The kidney here encapsulates the tumor on all sides and the tumor is still confined to the renal cavities. The patient survived and was well ten years later. $\frac{1}{2}$ natural size. (Mrs. K. M., age 61, July 13, 1900.)

kidney capsule, having a definite capsule of their own. In many cases they are distinctly degenerating, showing hemorrhages and hyalin areas. The general color is sulphur-yellow. The microscopic appearances of the small growth strongly suggest that of the normal adrenal gland, and indeed, occurring in the adrenal gland, they would be spoken of as simple hyperplasias. There is a net-work of capillaries, and on these capillaries are set the typical large, clear cells, which are polygonal in outline, and contain a rather small

nucleus, lecithin and glycogen. The larger tumors, which are usually malignant, are, nevertheless, very distinctly incapsulated. Some of these reach enormous size. They frequently spring from the lower pole of the kidney and show a remarkable tendency to extend into the calices and pelves as well as the veins. (See Figures 411-416.) No one site is characteristic. Metastasis is by the blood current, as a rule. Almost every part of the body can be infected, and it is extraordinary how remarkably the metastasis mimics the

FIG. 416.—TRANSVERSE SECTION OF TUMOR SHOWN IN LAST FIGURE. The kidney has been bisected by the growth so that it is practically separated into two kidneys.

parent tumor in histologic structure. An excellent illustration of the extent of metastasis is shown in Figure 417. It is only very occasionally that the regional lymph glands are involved.

While the smaller tumors in histologic structure closely follow the adrenal type, it is remarkable what variations occur in the large growths; the polygonal cells are larger, and are often arranged in alveoli; abscesses and inflammatory spots are common. The microscopic appearances of the growth are well shown in Figure 418. Figures 419, 420, and 421 are sections from the same tumor, and serve well to illustrate the multiplicity of the pictures and to explain the frequent classification by the French authors of these growths as epitheliomata with large, clear cells. The tendency to classify them in this way is due to

Dr. Cousin
Private Hospital
"St. Barnabas"

FIG. 417.—HYPERNEPHROMA AND METASTASES. Malignant hypernephroma; the tumor originated in the left kidney and metastasized as indicated in the drawing, the first evidence of trouble being a swelling in the left axilla. The kidney at that time was just palpable; death occurred within six weeks, when the development of the growth and its metastases had reached the enormous extent shown in the picture. The subject in this case was insane.

the influence of Albarran and Imbert. It is also this type of tumor that has been so frequently called "perithelioma." Note the close association of the tumor cells with the blood-vessel walls.

Grawitz proffered the following reasons for believing that these growths were of adrenal origin: first, their position underneath the capsule; second, the type of cells so similar to adrenal cells; third, the characteristic fatty infiltration of the cells, which is never found in the kidney epithelium; fourth, the presence of a limited capsule; fifth, the arrangement of the cells in relation to the stroma, so like that of the adrenal cortex. Louis B. Wilson (*Ann. Surg.*, 1913, lvii, 522) entirely throws aside the conclusions of Grawitz and accepts those of O. Stoerk (*Beitr. z. Anat. u. z. allg. Path.*, 1908, xliii, 393). Wilson, however, differs a little from Stoerk in that he considers that the tumors start from little islands of nephrogenic tissue which have never been connected with the pelvis of the kidney, while Stoerk holds that they develop from regenerating convoluting tubules. The arguments used against Grawitz are: that the tumors do not contain fat; that they are occasionally present in the lower pole of the kidney, where there are never adrenal rests; that they are never in the kidney capsule, where these rests invariably are found; and that they almost invariably contain tubules—a structure never found in the adrenal.

We have no personal observations upon which to base judgment as to the relative truth of these two theories. Many authors hold that these growths are of connective tissue origin and some that they are due to a metaplasia of the renal epithelium. They are distinguished from other tumors by their slow growth, large size, and relative benignity.

MALIGNANT GROWTHS OF THE RENAL PELVIS AND URETER.

As already stated, these growths are the papillomata, the papillary epitheliomata, the epitheliomata and the sarcomata.

Papilloma and Papillary Epithelioma.—Albarran and Imbert ("Les tumeurs du rein," Paris, 1903, 450) found in a series of 54 cases of primary tumor of the renal pelvis and ureter that 22 were papillomata. They usually arise in the pelvis of the kidney, but occur also in the pelvis of the ureter. They are frequently unilateral but sometimes bilateral. Hurry Fenwick ("Ureteric Meatoscopy in Obscure Diseases of the Kidney," 1903, 84) reports recurrence in the ureter one year after removal by nephrectomy from the pelvis of the kidney. In Wilson's paper (*loc. cit.*) it is stated that there were three papillomata of the renal pelvis out of a total of 92 tumors. In Bloch's 126 cases

FIG. 418.—VARIATIONS IN STRUCTURE OF DIFFERENT PARTS OF TUMOR SHOWN IN FIGURE 412. The various magnifications and areas from which pictures are taken are indicated by rectangular figures and arrows. The 80 times magnification shows the regular alveolar arrangement and the large clear cells. In the 240 times magnifications, at the top of the picture, the open structure of the new growth is shown to the right, and the more compact structure of the older growth in the center; in this, the nuclei of the cells show great variations in size, shape, and staining. In the drawing to the left at the top of the picture, the cells appear crowded together, as by pressure. This may be due to the influence of the surrounding blood.

6 were papillomata of the pelvis. The growth is usually multiple. It is soft and velvety and floats out when placed in water. On microscopic examination a small central blood vessel is made out, running up the center of each

FIG. 419.—SECTION THROUGH EDGE OF TUMOR SHOWN IN FIGURE 411. To the left is shown a portion of the fibrous capsule of the kidney. To the right the tumor. Note the alveolar structure, the large clear cells, the tendency to hemorrhage into the alveoli, and the irregularity as to number of layers of cells lining alveoli. About 100 times magnified. (From J. L. Yates.)

projection and covered with the many layers of typical pelvic epithelium (Fig. 422). The growths are identical in appearance, both macroscopically and microscopically, with papillomata of the bladder. They show the

FIG. 420.—SECTION OF TUMOR SHOWN IN FIGURE 411 UNDER SLIGHTLY GREATER MAGNIFICATION. Showing alveoli containing blood, also blood vessels at upper margin in connective stroma. (From J. L. Yates.)

FIG. 421.—ANOTHER SECTION THROUGH TUMOR SHOWN IN FIGURE 411. Showing arrangement of cells in solid masses. Here and there is an accumulation of blood between the cells. (From John L. Yates.)

FIG. 422.—PAPILLOMA OF THE RENAL PELVIS. The picture above on the left shows a section of the kidney from the capsule into the pelvis, which is the seat of papilloma, 8 times magnified. The medulla contains a cyst-like cavity partially filled by a blood clot containing tumor cells. This is shown 300 times magnified, following the arrow. The cortex, containing many tubules filled with blood, is clearly shown in the upper figure to the right. The large drawing below shows the portion of the kidney pelvis indicated by the square in the first figure, 80 times magnified. The finger-like projections, with a core of connective tissue containing blood vessels, are covered by many-layered transitional epithelium. Note further the sharp delineation between the epithelium and the connective tissue. One of these finger-like processes, indicated by a rectangle, is seen magnified 300 times, just above. There is a remarkable regularity in the shape of the cells and the nuclei and an absence of irregular mitosis, the central blood vessel is thin-walled. (Path. Lab., Boston City Hospital, No. 2754.)

same tendency to malignancy, not only by invading the deeper tissues, but by metastasis. If this condition has developed we have the papillary epithelioma. In the deep parts the cells are grouped together, giving an alveolar aspect. The renal parenchyma is almost invariably involved.

Epithelioma.—An interesting growth is that first observed by Kundrat (*Wien. klin. Wchnschr.*, 1891, iv, 949) and Rundle (*Med. Week.*, 1895, iii, 555). These growths originate either in the pelvis of the kidney or in the ureter, and are made up of layers of flat epithelium which tend to infiltrate in nodules. The growth is something like that found in lip cancer. N. Hallé (*Ann. d. mal. d. org. génito-urin.*, 1896, xiv, 617) is of the opinion that these cancers take their origin from plaques of leukoplakia. Wilson (*loc. cit.*) found one of these cases in his series and attributes it to embryonic Wolffian remains.

Sarcoma.—Sarcomata of the renal pelvis and ureter occur, but are of great rarity. They need no description here.

EMBRYONIC TUMORS.

The title "embryonic tumor" is most properly given to the interesting group of tumors known as neoplasmata, because they definitely develop from embryonic kidney structures. The name "nephroma embryonale malignum" was given by Birch-Hirschfeld, who was the first to recognize the histogenetic origin of the growths. They had been previously classified as sarcomata, carcinomata, adeno-carcinomata, myosarcomata, etc. They are all characterized by the fact that they contain at least two and sometimes three or four tissue elements.

Since F. V. Birch-Hirschfeld's original contribution (*Beitr. z. path. Anat. u. z. Allg. Path.*, 1898, xxiv, 343), a number of interesting and valuable papers have appeared. Especially valuable are the papers of Max Trappe (*Frankfurter Zeitschrift f. Path.*, 1907, i, 109); Heinrich Klose (*Beitr. z. klin. Chir.*, 1911, lxxiv, 9); Edward Garceau ("Tumors of the Kidney," 1909, 150); Watson and Cunningham ("Genito-urinary Diseases," 1912, ii, 236); and Jenckel (*Dtsch. Ztschr. f. Chir.*, 1901, lx, 500).

These tumors, which represent the majority of the malignant growths in children, are rare in adults. Only two perfectly clear cases are on record in adults, those of Muus (*Arch. f. path. Anat. u. Phys.*, Virchow, 1899, clv, 406) and Jenckel (*loc. cit.*). Tumors of this class have been found in new-born infants. Steffen ("Die malignen Geschwülste im Kindesalter," 1905) states that in 219 cases 168 occurred in the first five years of life. George Walker

(*Ann. Surg.*, 1897, xxvi, 529) in 142 cases found 116 in the first five years of life. He also notes that in 73 cases the left kidney alone was involved, in 58 the right kidney alone, and in 37 both kidneys. These embryonic tumors of the kidney constitute a large proportion of all malignant tumors of childhood. Hirschsprung in 29 cases of cancer in children found the kidney involved 15 times. These figures contrast with the general cancer statistics of W. R. Williams (*Brit. Med. J.*, 1899, ii, 1281), which state that, in 8,371 cases of malignant tumors in adults, only .3 per cent. were in the kidney.

The characteristic pathologic condition is that the tumors are composed of several different kinds of tissue, and that they represent malignant changes in the entire tissues of the embryonic kidney. Max Trappe (*loc. cit.*) was the first to demonstrate this forcefully and clearly, and has brilliantly illustrated

it as shown in the reproduction in Figures 423, 424, 425, and 426. Note the resemblance between the normal embryonic kidney and the malignant tumor. With the exception of these tumors the kidney tumors of childhood are mostly benign—fibroma or lipoma. Franck (*Beitr. z. klin. Chir.*, 1910, lxvi, 11) reports a true hypernephroma in a child 8½ years old, and notes that only three other cases are on record. The growths often attain immense size, which especially impresses the observer when the small body of the child is compared with the growth. They are very irregular in shape, mottled in color, often extend into the veins like the hypernephromata, oftener still into the pelvis of the ureter, are rarely encapsulated, do not metastasize very rapidly. Walker found metastases 55 times in 142 cases, the lungs and liver being the organs

FIG. 424. — EMBRYONIC TUMOR. Section from tumor shown in Fig. 423, composed more completely of the tubules. (Max Trappe, *Frankfurter Ztsch. f. Path.*, 1907, i, 130.)

FIG. 423.—EMBRYONIC TUMOR. Showing the definite tubular bodies lying in the embryonic sarcomatous connective tissue bases. (Max Trappe, *Frankfurter Ztsch. f. Path.*, 1907, i, 130.)

oftenest involved. On microscopic examination, gland structure, smooth muscle fiber, embryonic connective tissue, and sometimes cartilage are found. A high-

power magnification is well shown in Figure 427, taken from W. Grohmann (*Arch. f. path. Anat. u. Physiol. u. klin. Med.*, 1899, clv, plate 10). The

muscle fibers, closely resembling normal muscle fibers, lie in a finely fibrillated tissue with few nuclei. Garceau (*loc. cit.*), in 100 cases, found the striated muscle 42 times and the gland structures 50 times. The glands are lined either by single layers of high epithelium or by several layers, and often contain pearl-like bodies. Many interesting speculations as to the histogenetic source of these tissues have been made, but no definite conclusions attained. The interested reader is referred to the original literature.

FIG. 425.—TYPICAL EMBRYONIC KIDNEY BETWEEN THIRD AND FOURTH MONTH. Note remarkable resemblance to tumor shown in Figures 423 and 424. (Max Trappe, *Frankfurter Ztsch. f. Path.*, 1907, i, 130.)

The most characteristic fact in regard to the symptoms is that tumor and emaciation are usually the only signs. Occasionally there is pain and very

infrequently hematuria. The patients rarely come to operation except in a few of the large children's hospitals, such as the Great Ormond Street Hospital in London. Dr. George Waugh, of that institution, has a number of these patients every year. In the 80 malignant tumors reported by Wilson from the Mayo Clinic at Rochester, Minn., only three belong to this group, while Bloch, in 126 cases from Israel's clinic, found five. The tumors must be differentiated from other abdominal tumors, which can be done along the lines laid down for distinguishing renal infections from other varieties.

The treatment is exclusively surgical, the earlier the better. Taken early many of these children might possibly be saved. The primary death rate is high, according to Albarran and Imbert, 26 per cent. According to Klose there are only two or three cases in the literature where the patient has lived

FIG. 426.—ENLARGEMENT OF PREVIOUS SECTION, SHOWING GLOMERULI (Max Trappe, *Frankfurter Ztsch. f. Path.*, 1907, i, 130.)

FIG. 427.—HIGH MAGNIFICATION OF EMBRYONIC TUMOR, SHOWING GLANDS, STRIATED MUSCLE AND EMBRYONIC TISSUE.

st = striated muscle.
f = embryonic tissue.
k = glands.

(W. Grohmann, *Arch. f. path. Anat. u. Physiol. u. klin. Med.*, 1899, clv, plate 10.)

three years after the operation. Most of them die within a short time. Where no operation is done the average period of life varies from eight weeks to one and one-half years.

ADRENAL TUMORS.

Comparatively little is known about tumors of the adrenal glands, either as to their pathological classification or their clinical course. They are considered in this chapter solely because of the intimate relationship to the kidney, which makes their treatment occasionally a responsibility of the urological surgeon.

O. Ramsay (*Johns Hopkins Hosp. Bull.*, 1899, x, 20) has collected from

the literature a list of 67 malignant tumors, while R. Williams (*Lancet*, Lond., 1897, i, 1261) has emphasized the rarity of the condition by pointing out that

FIG. 428.—FIBRO-MYXO-SARCOMA OF RIGHT SUPRARENAL GLAND. The kidney is involved but is plastered down onto the thick capsule of the tumor and the ureter is flattened over the growth. The renal veins are patulous and free of growth. (Gyn. Service J. H. H., reported by Dr. Otto Ramsay, J. H. H. Bull., 1899, x, 20.)

in a series of 8,378 malignant tumors only one was found primarily located in the suprarenal glands.

N. Brüchanow (*Ztschr. f. Heilkunde*, 1899, xx, 38) has reported a list of 33 cases from Chiari's Pathological Institute.

Occurrence.—The disease may occur at any age from childhood on. It is equally common in both sexes. Ramsay observed it in 36 males and 26 females.

FIG. 429.—SECTION OF TUMOR AND GROWTH SHOWN IN FIGURE 428. The kidney is flattened out but normal, except for slight interstitial nephritis. The lymph gland above shows hyperplasia but no tumor cells. The center of the tumor is filled with yellowish, gelatinous material, and a few similar spaces are in the thick wall. The inside lining of the cyst is almost structureless fibrous tissue; deeper in the wall we find irregular groups of cells varying from round to large cells with several nuclei. In places, there is definite myxomatous degeneration. There are no remains of adrenal tissue. The tumor had been noted in the abdomen one year before operation, during which time it had increased rapidly in size but there were no metastases. The patient, operated upon in Jan., 1897, made an uneventful recovery.

Classification of Tumors.—These tumors may be classified as benign and malignant or as solid and cystic. The greatest confusion exists in the classification, as would be expected when one considers the rarity of the specimen.

The benign tumors, with the exception of cysts, are usually small, rarely give symptoms, and are principally known from accidental findings in autopsy examinations. Excellent accounts of these tumors can be found in

"Tumors of the Kidney," by Garceau, 1909, 274-301, and in the papers of Blackburn (*Am. J. Med. Sci.*, 1906, n. s., cxxii, 266) and Brüchanow (*loc. cit.*). Among the solid growths are lipoma, ganglio-fibromeuroma, myoma, angioma, and benign hypernephroma. This latter has been described by Virchow as a simple hyperplasia of the parenchyma. It often shows cyst formation which, in some cases, may be quite a large accumulation.

In addition to the cysts found in this so-called hypernephroma of the adrenal, there are also cysts due to echinococcus, and cysts of small size lined by glandular epithelium, and finally pseudo-cysts, which are simply accumulations of blood or serum.

In Figures 428 and 429 is pictured a very large cystic tumor of the adrenal, which was removed along with the kidney. This was classified by Dr. Otto Ramsay (*loc. cit.*) as a cystic degeneration of a sarcoma. Careful study of his findings would seem to indicate that we were perhaps dealing with some simpler form of adrenal cyst, a fact further supported by the patient remaining perfectly well. Terrier and Lecène (*Rev. de chir.*, 1906, xxxiv, 321), up to the time of their publication, could only find ten cases recorded in the literature.

Malignant Tumors.—While cases of malignant growths are on record under various names, such as carcinoma, sarcoma, malignant struma, malignant hypernephroma, and endothelioma of the adrenal, their classification all together as malignant hypernephromata, which Garceau adopts, seems the only feasible plan.

Under various names the same type of tumor is always described. The growths may be either single or multiple. Frequently both adrenals are involved. Occasionally the growths develop into very large tumors. Metastasis is likely to occur through the blood-vessels—the lungs, liver, and bones being predominantly affected. In little children metastasis to the bones of the cranium has been observed, so that at the Great Ormond Street Hospital in London such a growth on the skull is regarded as almost pathognomonic of primary adrenal tumor. The microscopic studies show groups of cells arranged in columns closely resembling cells of the normal adrenal cortex. Between groups of cells run thin-walled capillaries. The groups of cells are further divided by fibrous tissue septa, running in from the capsule which usually surrounds the growth. This arrangement in the malignant tumor is closely simulated in the benign. Microscopically, the growths resemble the so-called hypernephromata of the kidney, but can readily be distinguished through the absence of the tubular arrangement found at one point or another in the latter growths.

Symptoms and Course.—The benign tumors practically never give rise to symptoms, and, presumably after attaining their maximum size, which is rarely larger than a hazelnut, remain stationary for years. The malignant growths sometimes remain stationary for long periods and, again, they develop and metastasize most rapidly. With the cystic tumors a palpable mass in the side is occasionally observed. Garcean notes that the chief symptoms of malignant growths are loss of strength and weight, frequently accompanied by marked gastric and intestinal disturbances; tumor and pain may ultimately develop, and occasionally the bronzing of the skin characteristic of Addison's disease. Ramsay (*loc. cit.*) noted this bronzing in three out of his 37 cases.

In addition to the symptoms mentioned, a remarkable feature in fully one-half the cases recorded in children is a tendency to premature development. This not only affects the genital system and the hair, but also the general muscular development. Linser (*Beitr. z. klin. Chir.*, 1903, xxxvii, 282) suggests that this tendency to rapid growth is due to the fact that these tumors function as adrenal glands. This author reports a remarkable case of a boy five years and seven months old who, in association with a hypernephroma of the left kidney, showed a general degree of bodily development equal to a child of at least 15 or 16. The patient died from an operation undertaken for the removal of this tumor, and no cause for his premature development other than the adrenal tumor could be found in a careful autopsy investigation (Fig. 430).

Diagnosis.—The diagnosis rests on the facts brought out in regard to the symptoms. In children pigmentation of the skin, or metastases to the bones of the head, or premature development, all point to the disease, particularly if there is a tumor in the side. In the adult the same symptoms, plus a careful

FIG. 430.—REMARKABLE CASE OF GIANTISM ASSOCIATED WITH ADRENAL TUMOR. From autopsy and clinical record in five-year old boy. (P. Linser, *Beitr. z. klin. Chir.*, 1903, xxxvii, 282.)

exclusion of renal tumor by functional test methods and skiagraphy, will point to the disease. Absolute diagnosis can never be made except by operation.

Treatment.—The treatment of a tumor of the adrenal, when diagnosis is made, is purely surgical. As yet, few such surgical operations have been carried out, as the disease is usually found to advance so rapidly that no statistics are available to prove the value of surgery. Practically all the operative cases have died in a short time following operation. An exception is offered by the cystic growths to which Otto Ramsay's case belongs.

As a preliminary to any operation, the relative functions of the two kidneys should be determined, and at operation the opposite adrenal should be palpated to determine, first, its existence, and second, the fact that it is not involved by the disease.

PERIRENAL TUMORS.

The first comprehensive report on these growths is contained in the publication of O. Mankiewicz (Thèse de Paris, 1887). They are very rare, although Rambaud (Thèse de Toulouse, 1904, 247) was able to collect 102 cases out of the literature. J. G. Adami (*Montreal Med. J.*, 1896-97, xxv, 621) collected 41 cases of lipoma in the retroperitoneal tissues. The disease is slightly commoner in women than in men, and is rare in childhood.

Classification.—It is convenient to classify these growths into the cystic and solid tumors. Practically all the cystic tumors are benign. The solid are both benign and malignant. The commonest cyst is a simple encapsulation of a perirenal hematoma. Some of the cysts are unilocular. Albarran (*Bull. et mém. Soc. de chir. de Par.*, 1903, n. s., xxix, 117) has reported a polyocular cyst. A. Krogius (*Nord. med. Arkiv.*, 1904, iv, pt. i, 1-29) reports a case where a perirenal cyst communicated with the kidney pelvis, and collects 10 other such instances from the literature. With the exception of the blood cysts and hydatid cysts it would seem that most of these growths developed from remains of the adrenal body. They are practically always unilateral, varying in size from little growths to immense collections holding hundreds of c. c. of fluid. The cyst wall is usually thin, made up of fibrous tissue, and frequently lined by a single layer of epithelium. The solid tumors are seldom found composed of the single tissue. Hartmann and Cunéo ("Travaux de chirurgie anatom.-clinique," Paris, 1904) note in 33 tumors that 6 were lipomata, 4 fibro-lipomata, 9 fibro-myxo-lipomata, 2 fibromata, 3 fibro-miomata,

5 fibro-sarcomata, 2 angio-sarcomata, and 2 mixed tumors. These mixed tumors, probably of Wolffian duct origin, are similar to the embryomata found in the kidney. They occur generally in adults. Most of these tumors take their origin from the tissues immediately around the kidney, and, with the exception of the sarcomata, do not involve the organ. Some of them attain great size, weighing many pounds.

Symptoms.—Excepting the sarcomata, these growths are of slow development and occasion, for a long time, no general or local disturbance except the development of tumors. The sarcomata are usually very malignant, leading to general metastasis and death within the first year. The lipomata may have a cystic feeling equal to that of the true cyst. Occasionally pain from pressure has been noted, and in a few cases varicocele.

Diagnosis.—As a rule, correct diagnosis is made only by exploratory incision. These tumors are nearly always mistaken for either ovarian or renal tumors.

Prognosis.—The prognosis of these tumors, when of large size, is nearly always serious, even if they are benign.

Treatment.—The treatment is exclusively surgical. In the case of cysts it is comparatively simple. The approach should be through the lumbar region. When the cyst is reached its contents should be evacuated and, when possible, the wall then stripped out. In the simple cyst, evacuation and drainage will suffice. Malignant sarcoma is invariably inoperable. When possible, with the non-malignant tumors, the kidney should be preserved. Microscopic diagnosis at the operating table is almost indispensable. According to Hartmann (*loc. cit.*), in many cases it is necessary to remove the kidney with the tumor in order to be sure of getting it all out. There is a marked tendency to recurrence even with the benign growths.

CYSTS OF THE KIDNEY, OTHER THAN POLYCYSTIC KIDNEY.

Cysts of the kidney are rare, with the exception of the tiny retention cysts found in so many cases of chronic interstitial nephritis, which have no surgical or clinical importance.

Excluding the echinococcus cyst, which has already been treated in Chapter XXII, the cysts may be divided into three classes: dermoids; retention cysts from obliteration of the main collecting tubule or tubules in a papilla of the kidney; and serous or sero-hemorrhagic cysts.

Dermoid Cysts.—Only three examples of dermoid cyst in the kidney are to

be found reported in the literature. The first is referred to by Paget ("Lectures on Surgical Pathology," London, 1853, ii, 34). Haeckel (*Berliner klin. Wchnschr.*, 1902, xxxix, 964) reports the removal of a small typical dermoid cyst from the right kidney of a woman, 58 years old, who recovered promptly from her operation. Dr. W. S. Goldsmith, of Atlanta (*Surg., Gyn., and Obst.*, 1909, viii, 400), removed a cyst measuring $7\frac{1}{2} \times 8 \times 5$ cm., along with the right kidney, from a young man 20 years old. The growth was in the upper pole of the kidney and had made itself manifest by pain and hematuria over a period of four years. Both this specimen and Haeckel's consisted of typical dermoid tissue, hair, and surface epithelium.

Retention Cysts.—Occasionally marked cystic transformation in a kidney is encountered from obliteration of a papilla or of several papillæ. Curtis and Carlier (*Ann. d. mal. d. org. génito-urin.*, 1906, xxi, 1) report the development of such a cyst from a tuberculous process in the kidney. In the chapters on Tuberculosis and Stone we have already described similar transformations of parts of the kidney. Striking specimens are shown in Figures 285 and 315.

Serous or Sero-hemorrhagic Cysts.—**OCCURRENCE.**—These cysts are apparently quite rare. J. Guinsbourg ("Contribution à l'étude des grands kystes du rein," *Dissert.*, Paris, 1903) was able to find, up to the time of his report, only 39 instances. We have had two cases (Figs. 431 and 432). They are met with oftener in women than in men, and usually in patients over 30 years of age.

ETIOLOGY.—The cause of these tumors has not been satisfactorily elucidated; some authors consider them retention cysts and others as belonging to the same group as polycystic kidneys. Neither explanation seems satisfactory.

PATHOLOGICAL ANATOMY.—These tumors are almost invariably unilateral. They vary in size from a diameter of one or two cms. to immense structures filling the entire abdomen. They are mostly situated at one pole or the other. J. Simon ("Contribution à l'étude des grands kystes séreux du rein," *Dissertation*, Paris, 1906) noted the location in 36 cases and found the lower pole involved 18 times, the upper pole eight times, and other parts of the kidney eight times.

In many instances the cyst wall has been found quite clear and thin, and has coursing in it blood vessels derived from the renal vessels. The cyst wall is made up of delicate fibrous tissue. Sometimes there is an incomplete lining of flattened, single, large, red, epithelial cells. Often the kidney parenchyma is but little altered. In some cases the wall of the cyst has become greatly

FIG. 431.—BLOOD CYST OF RIGHT KIDNEY. A diagnosis of ovarian cyst was made and the operation was done through a median abdominal incision. The cyst was first tapped and 2,300 c. c. of blood-stained fluid evacuated. The left kidney in this case was markedly hypertrophied, but normal. The patient survived the operation and was well ten years later. The small diagram shows the appearance of the patient's body before operation; the large one the appearance of the tumor after removal. (Mrs. E. H., age 49, Jan., 1900, Gyn. Service, J. H. H.)

thickened and very fibrous. The fluid content is serous and clear unless there has been hemorrhage, which is not uncommon.

SYMPTOMS.—As a rule, the patients with serous cysts of the kidney come to the physician complaining of nothing except tumor. This was the case with

FIG. 432.—CYST OF KIDNEY. Multilocular kidney cyst. The large cavity has apparently resulted from the breaking down and absorption of the walls of many small cysts. Note the intact condition of the two poles. This cyst contained 1,000 c. c. of clear fluid. The patient recovered promptly and a year later reported a normal pregnancy and labor. $\frac{3}{4}$ natural size. (Mrs. L. K., age 34, Apr., 1902, Gyn. Service, J. H. H.)

both of our patients. A few of the cases on record have been associated with hematuria. Récamier (*Ann. d. mal. d. org. génito-urin.*, 1893, xi, 185) reports a case where there were severe attacks of pain in the kidney region. When the tumor reaches great size it may occasionally cause disagreeable pressure symptoms.

DIAGNOSIS.—In large tumors, the diagnosis of ovarian cyst is usually made. The differentiation from hydronephrosis by ureteral catheterization and X-ray methods is simple. As a rule, the diagnosis is made only by abdominal exploration.

TREATMENT.—The treatment is purely surgical. Where it is possible to do so, a conservative operation, removing the cyst and leaving the kidney, should be carried out. This operation was first done and reported by Tuffier (*Gaz. hebd. de méd. et de chir.*, Paris, 1897, n. s., ii, 1135). In advocating his operation Tuffier stated that the death rate from nephrectomy for this condition was 45 per cent. In many of the large kidneys, such as the two shown in Figure 429 and Figure 430, conservative surgery is almost impossible. Provided careful preliminary demonstration is made that the other kidney has normal functioning power, nephrectomy should be possible without great risk. Often the greatest difficulty is in detaching the cyst from the peritoneum, just as in all other tumors of the kidney. For very large cysts the transperitoneal route is the best, while for small ones the lumbar route is better. Occasionally it is of advantage to remove a part of the kidney with the cyst. This might have been accomplished in the case illustrated in Figure 430. There is, however, considerable risk of renal fistula, and it is not always easy to exclude some possible malignancy.

POLYCYSTIC KIDNEY.

Although rare, this condition has long been recognized. Rayer, in 1839, accurately described as well as pictured it in his atlas.

Occurrence.—The disease occurs principally at two periods of life, immediately before or after birth, and after 40 years of age.

Sieber (*Dtsch. Ztschr. f. Chir.*, 1905, lxxix, 469) in a series of 173 cases found 107 occurred between the ages of 40 and 60. In our own clinical memoranda we find 8 cases recorded, all between the ages of 42 and 57, all in women, and all bilateral. Between birth and 20 years old Sieber was able to find in the entire literature 32 cases. The disease is a little commoner in women than in men. Some influence has been ascribed to heredity. Osler

observed cases in a mother and son ("Practice of Medicine," 1905, sixth edition, 716); Höhne (*Dtsch. med. Wchnschr.*, 1896, xxii, 757) in a mother and daughter. The disease is rare, as shown by the fact that Garceau found but 10 cases in 2,429 autopsy records of the Boston City Hospital.

Luzzato ("La degenerazione cistica dei reni," Venezia, 1900) in 226 cases found that 185 were bilateral. Sieber, in his report of 150 autopsy records, found that 140 were bilateral. That the disease is nearly always bilateral is well illustrated by its almost invariable recurrence in the opposite kidney after nephrectomy, as shown in a case of Dr. Roswell Park ("The Principles and Practice of Modern Surgery," 1907, 969).

Pathology.—As a rule, while both kidneys are affected, they are not equally involved. A common condition is that shown in Figure 433. The cysts are scattered throughout the entire kidney, particularly, however, in the cortex and in the two poles of the kidney. The pelvis is frequently markedly deformed. In contradistinction, however, to the narrow necks of the calices noted in hypernephroma, they are wide and flattened out, a fact which has been utilized by Dr. William F. Braasch (*J. Am. Med. Ass.*, 1913, lx, 274) in developing a diagnostic difference between the two types of growth through skiagraphic collargol pictures. It is not an uncommon occurrence to find stones in such a pelvis.

The cysts vary in diameter from a millimeter to two or more centimeters. Their actual size and appearance are well shown in Figure 434. The large cysts are formed from the coalescence of smaller ones. The contents are most frequently a clear fluid, which may become darkened by hemorrhage. The clear fluid is quite watery, and usually contains traces of urea. The cyst wall is made up of a thin layer of fibrous tissue upon which is set a single layer of cubical epithelium. This epithelium is frequently thrown into folds and projections simulating papilloma. When these little inversions are present the cystic contents are particularly marked by the large number of cells, which are quite free. This proliferation of cells is an evidence of the activity of cell growth. The secretory part of the kidney lies between the cysts, and, although most frequently markedly changed by a process of parenchymal atrophy and overgrowth of fibrous tissue in every way identical with that of chronic interstitial nephritis, it is preserved to a remarkable extent, which accounts for the ability of the organs to functionate sufficiently to sustain life. The arrangement of kidney parenchyma in relation to the cyst wall is shown in Figure 435.

Various theories have been advanced as to the cause of these tumors. Some authors have attempted to separate the congenital growths from those in the adult. They are, however, apparently identical. The theory that they are true new growths, strongly supported by C. Nauwerck and K. Hufschmid (*Beitr. z. path. Anat. u. z. allg. Path.*, Jena, 1893, xii, 19), has lost ground, and is not generally held to-day. There is also very little to support the view originally advanced by Virchow that they arise from an interstitial inflammation of the papillæ, with a resulting occlusion of the tubules.

The generally accepted explanation of the development of these tumors is that offered by G. C. Huber (*Am. J. Anat.*, 1904-5, iv, Supplement, 17), the essence of which is that in embryonic development a perfect union of the tubules of the renal vesicles with the primary collect-

FIG. 433.—BILATERAL CONGENITAL CYSTIC KIDNEYS IN THE ADULT. (J. H. H., Autopsy No. 1258, March 2, 1900.)

ing tubules has failed. Further evidence in favor of this view is the fact of the frequent occurrence of cysts in the liver accompanying the cystic kidneys. Sieber (*loc. cit.*) noted this in 39 of his 212 cases.

Moschowitz has also pointed out that in fetuses with double cystic kidneys, there are frequently other congenital anomalies, such as supernumerary fingers, etc. It would seem that the condition is dependent on a congenital tendency to malformation and overgrowth of certain tissues not confined to any one part of the body, but leading to more serious consequences in the kidneys

than elsewhere. The growth seems to be confined to the part of the renal tubule between the glomerulus and the collecting tubule.

Symptoms and Course.—The evidence is that polycystic disease of the kidney is a progressive non-self-limiting disease. In the congenital cases, a remarkable illustration of which is shown in Figure 436, the progress is rapid. Most of these fetuses are born dead, which is, in part, due to the great impediment which they occasion to labor. Those that survive birth almost invariably die in a few days either of asphyxia or inability to breathe, or from uremia.

The course in the adult is variable. In some cases it seems quite rapid and in others very slow. We recently saw a patient, forty years of age, who had no symptoms except tumor and practically no decrease in renal function, as evidenced by the phenol-sulphonephthalein and indigo-carmin tests. This slowness is witnessed in some of the cases of Sieber (*Dtsch. Ztschr. f.*

FIG. 434.—CORONAL SECTION OF RIGHT KIDNEY OF CASE SHOWN IN FIGURE 433. The kidney parenchyma lies in all parts of the kidney between the cyst cavities, particularly at the upper pole. $\frac{3}{4}$ natural size.

Chir., 1905, lxxix, 469), who were over 80 years old.

F. V. Milward (*Birmingham M. Rev.*, 1904, lvi, 476) divided the disease into three stages: first, progressive enlargement of the kidneys with no other

symptoms (from a few months to years); second, attacks of colic and pain of a dragging character in the kidneys, with the usual symptoms of renal insufficiency, such as headache, dizziness, disturbances of vision, anorexia, flatulence, diarrhea, and indeed all the symptoms of chronic interstitial nephritis; third, increase of all renal insufficiency symptoms up to uremic convulsions and

FIG. 435.—SECTION OF PORTION OF LARGE POLYCYSTIC KIDNEY. The arterial system is injected, showing that well-preserved glomeruli are present in great numbers and in all parts of the cortex, even in the thinnest septa, which explains the fact that such cystic kidneys are capable of maintaining the renal function to a remarkable degree.

coma. The complication of suppuration is marked by pain, fever, and the typical alterations of sepsis on the blood. Many die of anuria. Luzzato (*loc. cit.*) notes this form of exitus in 24 out of 38 deaths. In this third stage there are the high blood pressure and left heart hypertrophy characteristic of interstitial nephritis, and not a few of the sufferers die from apoplexy. In the early stages the urine may be practically normal. In the last stages there are invariably the marked polyuria and low specific gravity met with in chronic interstitial nephritis. Patients with general symptoms of renal insufficiency

will invariably show this by the functional test methods. In the early stages, however, as already stated, these tests may show nothing.

FIG. 436.—BILATERAL CYSTIC KIDNEYS IN STILL-BORN BABE. There were seven digits on right hand, six on left, a brain cyst and spina bifida. Note the enormous distention of the abdominal cavity due to the enlarged kidneys. The right kidney is monolocular, the left kidney multilocular. The small drawing above shows the details of structure of the left kidney. (From Dr. J. Whitridge Williams, Jan. 26, 1899.)

Diagnosis.—When the disease is located much more on one side than the other, so that the tumor is unilateral, there is the necessity of distinguishing the growth from hydronephrosis and renal tumor. Hydronephrosis is readily excluded by a catheterization of the ureter. If the sac is open, the large pelvis

can be readily measured. If the sac is closed, there is no secretion of the urine, which would not be the case with polycystic kidney. The pyelograph following collargol injection affords valuable distinguishing points between neoplasm and cystic kidney. It cannot, however, be accepted as final, and some cases can only be properly diagnosed by surgical exploration down to the growth. On the left side it is sometimes difficult to separate this condition from a splenic tumor. We have observed one case of cyst in the tail of the pancreas that from its location closely simulated a growth in the left kidney.

Treatment.—The treatment is largely symptomatic. When general symptoms have arisen, the regulation of the general habits of diet, exercise, water drinking, and bowel evacuation should be carried out in such a way that as little tax as possible is put upon the kidney. Albarran and Imbert ("Les tumeurs du rein," Paris, 1903, 576) report a list of 34 nephrectomies with nine primary deaths, one a few weeks after operation, four within a year. Only two of the cases followed up survived seven years; a number were lost sight of. Nephrectomy should, under no circumstances, be carried out in cases of polycystic kidney.

Among the palliative procedures which have been proposed are nephrotomy, decapsulation, and puncture of the cysts. This latter method is by far the simplest and best thing to do. There are, however, no very convincing reports of permanent relief from it. Probably there is a rapid recurrence of the fluid. It should be remembered, too, in deciding upon such an operation, that these patients take anesthetics very badly, as they frequently bring on uremia and death.

GENERAL SYMPTOMS OF MALIGNANT TUMORS OF THE KIDNEY.

Unless pieces of the tissue are passed spontaneously or removed by the catheter, a differentiation of the types of renal tumor is not possible. The general symptoms, therefore, can well be considered together; the classical group consists of three: hematuria, tumor in the side, and pain. It is the exception to meet with all three of these symptoms in the same case. Braasch (*J. Am. Med. Ass.*, 1913, lx, 274) notes that in only 32 of 83 cases were all three symptoms present. Hematuria was the initial symptom in 104 of the 126 cases reported by Bloch (*loc. cit.*). Braasch observed it occurring in 64 per cent. of his cases; it was a primary symptom in 26 per cent. of them, and the only symptom in 12 per cent. The hematuria is usually total and not terminal. It is likely to be intermittent. Often it is microscopic, but sometimes it is very severe, large casts of the pelvis and ureter being passed.

Tumor, which is the characteristic symptom in children, is much less frequently noted in the adult. Albarran and Imbert (*loc. cit.*) in 303 cases note that tumor was complained of or made out by the examining physician 295 times. In Bloch's cases only about 20 per cent. had noted tumor, but in 80 per cent. tumor was found on examination. These findings almost exactly correspond to those of Braasch, where tumor was made out in 78 per cent. of the cases. In his tumor cases the growth was freely movable in only 6 per cent., and firmly fixed in 18 per cent. of the cases.

Pain is very common. It may occur as a dull ache or as violent attacks of colic. In Braasch's series it was observed in 82 per cent. of the cases, was a primary symptom in 32 per cent., and a single symptom in 18 per cent.

An interesting manifestation observed in the male and considered of great importance is the development of varicocele. This symptom was given importance years ago by Guyon. Various reasons for it have been advanced: first, direct pressure of the tumor on the spermatic vein; second, pressure of lymph glands on the vein; third, it has been suggested that it is due to a general dilating effect caused by absorption from the tumor. It is, no doubt, often due to extension of the malignant process into the renal vein and vena cava, resulting in a passive hyperemia of the underlying regions of the body.

Left alone, the disease progresses continuously and results in death. The variations between the different types have already been pointed out. Some of the hypernephroma cases live for years. There is often marked cachexia early in the pure cancer cases.

James Israel (*Cntrlbl. f. Chir.*, 1911, xxxviii, 10), in 146 malignant tumors of the kidney, has noted that in 8.2 per cent. of the cases there was fever. The fever was associated with the end stages of the disease and with cachexia. There was also an initial fever, which might be the only symptom, and in some of the cases a fever which came and went during the course of the disease. These fevers may be intermittent, remittent, or continuous.

The differential diagnosis is not always easy. The investigator usually has to work out the cause of pain, hematuria or tumor in the abdomen. The presence of varicocele should always suggest the importance of investigating for kidney tumor. Since the X-ray has given us positive help in differentiating stone kidneys, the presence of tumor, plus hematuria, almost invariably means neoplasm. When there is no tumor, but simply pain and hematuria, it is often necessary to separate the condition from essential hematuria. This diagnosis is sometimes impossible to make. The persistence of hematuria, especially when severe, is indication for operation. When tumor alone is present,

FIG. 437.—VIEW OBTAINED AT OPERATION OF LARGE HYPERNEPHROMA. Shows the extensive incision necessary for exposure and enucleation of tumor. Both the XII and XI ribs are divided, permitting the lifting up of the lowermost part of the thorax like throwing open a barn-door. (For details of incision see Figure 191.) The huge engorged veins are seen coiling over the surface of the tumor and running into the peritoneum and all the neighboring viscera. Each of these capsular veins had to be doubly ligated and cut between, as hemorrhage on injury to any one of them may be enormous. The retractor lying directly across the body pulls over the peritoneal sac and exposes the renal veins choked with tumor masses. The tumor has the whitish, nodular character characteristic of hypernephromata. Recovery after enucleation with recurrence later. (Dr. M., San., Oct. 16, 1909.)

and there is no secretion from the affected side on catheterizing the ureter, it is sometimes impossible to distinguish between a closed pyonephrosis and a renal tumor. It is necessary to distinguish between tumors of the kidney and tumors of other organs. Marked deficiency in function of the kidney of the suspected side points to its being the site of the disease. If the function, however, is found good, the contrary cannot be assumed, because in tumors of the renal pelvis, as well as hypernephromata, there is frequently no impairment of the renal function. Braasch has greatly added to our differentiating power by the introduction of his pyelography method for renal tumors. He emphasizes the following points (see Chapter on X-ray): first, retraction of one or more calices; second, partial obliteration of the pelvic lumen; third, irregularities of the pelvic cavity; fourth, retraction and dilatation of the upper ureter; fifth, abnormal position of the renal pelvis.

TREATMENT.

Up to the present time neither a specific serum, drug, X-ray, or radium treatment has been successful in this disease. The sole effectual treatment to-day is operation, and, in our opinion, nephrectomy. According to Legueu (*"Traité chirurgical d'urologie,"* Paris, 1910, 827), partial nephrectomy has been done eight times. In doing nephrectomy, for malignant disease of the kidney, it must be borne in mind that the operation must be radical. The entire capsule and upper ureter must come out with the mass and usually the adrenal gland. The widest kind of incision is necessary. These operations are fully described in Chapter XIV. The simple lumbar route is applicable only to those cases in which the kidney is not too greatly enlarged and is freely movable. The best plan is the para-peritoneal in front, although there is no objection to the transperitoneal route when it is found necessary. According to Bloch, no patient with a fixed tumor mass has ever remained well after operation, and Israel's results, when there is marked varicocele, have also been very bad. He, therefore, considers these two findings a contra-indication to operation. Very wide incisions are necessary in order to thoroughly control hemorrhage. A good one is shown in Figure 437. The immense size of tumor removed through this incision is shown in Figure 438. In Figure 439 is illustrated a method of removing a plug of tumor tissue from the renal vein.

Results of Operative Treatment.—The permanent as well as immediate results depend greatly on the types of tumor and the stage that they have attained.

FIG. 438.—LONGITUDINAL SECTION OF TUMOR SHOWN IN LAST FIGURE. Note honey-combed appearance. There is a plug of the tumor in the renal vein and a plug in the pelvis hanging from an upper papilla. A small amount of renal parenchyma is seen at the lower pole. The microscopic sections show essentially the same structure as those pictured in Figure 418.

Rafin (*Ann. d. mal. d. org. génito-urin.*, 1911, xxix, 2006) reports his results in 20 nephrectomies; 7 died immediately from operation, 5 within the next two years, and 10 remained well for longer than three years. Bloch in 126 cases noted a primary death rate of 22.2 per cent.; of these deaths 12 were

FIG. 439.—METHOD OF REMOVING TUMOR PLUG FROM RENAL VEIN AND VENA CAVA. A circular incision is made around the renal vein, after having placed a purse-string suture proximal to it. The cava is compressed above and below the incision of the veins, taking care to include the opposite renal vein in the pressure. The tumor and the plug are withdrawn. If adherent, they are carefully liberated and the purse-string drawn tight. A ligature may then be added. Such plugs are not infrequently found in association with hypernephromata.

from prolapse, nine from heart failure within eight days after the operation, seven from pneumonia, emboli, and intestinal paralysis. He was able to get careful records of the remaining cases in 91 instances. Of the patients who died with metastasis, it invariably showed within two and one-half years. After three years, 27.7 per cent. of the patients were still living, and at the end of five years, 25 per cent.

Braasch reports a primary death-rate of 11 per cent., and a five years' cure in 10 per cent. of the patients.

The lesson from these statistics is that every suspected case should be investigated and treated as early as possible, and there can be no doubt that under this plan the number of patients permanently cured will increase in the same proportion as observed in cancer in other parts of the body.

CHAPTER XXVI.

SURGICAL TREATMENT OF BRIGHT'S DISEASE.

GENERAL CONSIDERATIONS.

In its application to Bright's disease, surgery trenches upon a field peculiarly the property of internal medicine. Practitioners of medicine since Richard Bright, who made known the disease which bears his name, have gone on treating patients suffering with nephritis without the remotest idea of any assistance from surgery. The conception and practical application of surgical operation to the treatment of nephritis we owe to the late George M. Edebohls, who reported his first experience in the *Medical News*, 1899, lxxiv, 481.

Etiology.—True Bright's disease must be clearly distinguished from infectious nephritis or its complications. The term nephritis is misleading, because its proper meaning is definitely associated with the conception of inflammation, while Bright's disease is essentially a degenerative process of the cells making up the secreting parenchyma of the kidney. It does not fall within the range of our purpose in this chapter to consider the evidence upon which the theories as to the cause of Bright's disease are based. While it is clearly recognized that an acute poison, either a drug like carbolic acid or a toxin of some bacterial invaders like that of scarlet fever, can bring about the acute degenerations of acute nephritis, and that this may continue and develop into chronic nephritis, it is not at all certain that all the nephritides are due to the irritation of injurious substances in the blood. Some of the chronic changes may well be due to lack of inherent vitality in the secretory cells or to improper circulation of the blood. It is this last idea that inspired Edebohls. No more can we consider the complicated pathological and clinical findings. The reader is referred to the many text-books on medicine for this information. Here we will but recall the elemental facts in regard to the condition.

Pathology and Symptoms.—In acute nephritis, or, as it is better called, acute parenchymatous nephritis, the connective tissue framework of the kidney is unaffected, there is the well-known cloudy swelling of the tubules and glomeruli. In some instances the change is mostly glomerular. In such cases the

urine is scanty, containing albumin, blood cells, and many casts; the chlorids are not well excreted and there is an accumulation of water in the tissues, known as edema, or in the body cavities as ascites. If the tubules are much involved there follow vomiting, headache, uremic convulsions, and in the extreme cases convulsions and death. Geraghty and Rowntree have shown that phenol-sulphonaphthalein is well excreted so long as the tubules are intact, but in the extreme cases, in the last stages, scarcely at all. The fact to be remembered in connection with acute nephritis is that in many cases it spontaneously and rapidly recedes and leaves apparently normal organs.

Chronic nephritis is divided into two groups, the parenchymatous and the interstitial cases being clearly distinct, although the parenchymatous in its end stages may closely resemble the end stages of the interstitial variety. In the milder parenchymatous cases there occur the edemas and dropsies and urine findings of the acute glomerular disease, and in the last stages, in addition to these, uremia and coma. In the chronic interstitial type the glomeruli are but little affected, the disease consisting of atrophy of the tubules and overgrowth of the intertubular connective tissue; the urine is increased in amount, contains few casts, often no albumin, and a dye, like phenolsulphonaphthalein, is poorly excreted. The substances accumulating in the blood lead to arteriosclerosis, high blood pressure, hypertrophied heart. In the end there is uremia and exitus.

The gravity of chronic nephritis rests in the generally accepted belief that it is steadily, although usually slowly, progressive, and that once set going it does not hold up, and is not influenced, except symptomatically, by any known treatment.

HISTORY OF SURGICAL TREATMENT.

George M. Edebohls conceived the idea of improving or curing Bright's disease by decapsulation of the kidney and by the establishment of numerous new depurating anastomotic vessels by way of the surface of the kidney. Edebohls was led to the conclusion that such an artificial vascularization would improve most and cure some cases of Bright's disease by noting the fortunate effects in three out of five cases in which he had fixed the kidney with a partial detachment of its capsule, in the presence of a unilateral chronic renal inflammation. His first case was that of a woman, twenty years old, operated upon January, 1898, suffering from mobility of both kidneys and an interstitial nephritis. Albumin and casts disappeared permanently from the urine one month after the operation, and a year later she was well.

Edebohls next states (1901): "Encouraged by the permanent cures of chronic nephritis, I have during the recent years performed nephropexy by preference upon patients suffering from chronic Bright's disease. Of 191, therefore, upon whom nephropexy was performed, 16 suffered from a chronic inflammation of one or both kidneys."

It is interesting to know that Edebohls' first idea was that the cure of Bright's disease in several of his cases was due to the correction of a displacement of the kidney; it did not occur to him until later that the decapsulation was the efficient agent.

Dieulafoy enters a protest against designating as Bright's disease either those cases in which the sole symptom is albuminuria with casts in the urine, or those in which but one kidney is affected. If one of the kidneys remains free, the secretion of the urine is sufficiently assured to obviate the uremic sequelæ, and the case cannot properly be labeled one of Bright's disease, but must simply be designated as a unilateral chronic nephritis.

Edebohls considered that decapsulation was indicated in all varieties of chronic nephritis. His conclusion is expressed as follows: "I am ready to operate upon any patient with chronic Bright's disease who has no incurable complication, or one absolutely forbidding the use of an anesthetic, and whose probable expectation of life without operation is not less than a month."

Reginald Harrison (*Lancet*, 1896, i, 18) arrived at a somewhat similar conclusion by a totally different path. He operated upon three cases, in the first of which he cut down upon the kidney of a young man eighteen years of age, who had scarlatinal nephritis, expecting to find a suppurating kidney. Instead of this, he found a kidney distended with inflammatory products and closed the wound. There was a free discharge of blood and urine for several days, and the wound healed in the course of ten days. After this incision the excretion of urine became far more abundant and the albumin gradually and completely disappeared.

He operated again, this time upon a man fifty years of age for a stone in the right kidney, associated with pain, hematuria, and albuminuria; he opened and explored the kidney but found no stone. There was a prolonged discharge of blood and urine, and following this operation the urine became normal. He operated, a third time, upon a woman, forty-four years old, with hematuria and occasional albuminuria, believing she had a calculus, and found a swollen, tense left kidney. The patient made a complete recovery following a free drainage of the urine, with some blood.

He argued that the cure was effected by relieving the tension, the operation

in each case being a simple section of the capsule of the kidney without decapsulation.

Let us consider Edebohls' results:

Edebohls' Results in Seventy-two Cases of Nephritis.

Variety of nephritis	Deaths occurring within two weeks of operation	Ultior deaths from chronic nephritis	Ultior deaths from other causes	Unimproved	Improved	Cured	Result unknown	Total
Chronic interstitial.....	4	8	2	..	4	10	3	31
Right chronic interstitial and left chronic diffuse.....	..	..	1	1	1	1	..	4
Chronic diffuse.....	2	4	3	..	13	3	..	25
Chronic parenchymatous...	1	1	3	2	2	3	..	12
Total.....	7	13	9	3	20	17	3	72

In the seventeen cured cases, ten are labeled chronic interstitial, three chronic parenchymatous, three chronic diffuse, and one chronic interstitial on the left side—left chronic diffuse.

The average time it took the urine to clear up was eight months; in one case, it was one month, in another two, and in yet another three. The remaining cases took varying periods up to twenty and thirty months. The average length of time since the seventeen operations was four years.

This matter is one of such importance that in conclusion we summarize Edebohls' statements: Of sixteen sufferers from chronic nephritis who came to him for operation, in whom death was immediately imminent by virtue of the disease, nine were saved by operation, while in seven the attempt to save life failed. Of twenty-two remote deaths none were due to operation. Thirteen of the twenty-two ultimately died of chronic nephritis, but of these only six received no appreciable benefit. The rest were more or less benefited, all experiencing decided improvement in general health and in the condition of the urine, while a majority of the twenty appeared to be on the high road to complete health, and were expected to figure among the cures in the next report.

The best results are obtained in cases of edema associated with the passage of small amounts of urine. The chances of success lessen in the following

order: edema alone, edema with uremia and oliguria, edema combined with uremia, and finally uremia pure and simple.

Patients with uremia, edema, and oliguria are more likely to be benefited than those with edema alone or those with edema and uremia.

Pousson draws these important practical conclusions: When uremia is added to the other manifestations or acute crises of Bright's disease, the outcome is less likely to be successful. The expectation of a good result is still less when there is a diminution of the urinary secretion without edema.

Of the seventeen cures of chronic Bright's disease obtained as results of the operation, the writer says: "They alone in themselves justify the work done, even if the others had experienced no benefit."

James Tyson and C. H. Frazier report a remarkable case of a girl nine years old, who had had a scarlatinal nephritis four years previously. A year later she had an acute nephritis with albuminuria and general anasarca. After repeated relapses she came under the observation of Dr. Tyson, with general anasarca, ascites, albuminuria, and casts. The abdomen was enormously distended and the face was so swollen that the eyes were almost closed.

After considerable treatment she was operated upon by Dr. Frazier, who decapsulated the right kidney.

For the first week after the operation the urine excreted, day by day, amounted (in ounces) to $21\frac{1}{2}$, $42\frac{1}{2}$, $72\frac{1}{2}$, 102, 63/60. In ten days the ascites and anasarca had entirely disappeared and the albumin had fallen from one-half to one-tenth the volume of the urine tested.

Two months later the left kidney was decapsulated, and three weeks after this the patient was noted as free from dropsy. She continued in apparent good health for more than one year, when she died after exposure during a severe winter.

INDICATIONS FOR OPERATION.

The cases of acute nephritis following fevers, more especially the nephritis associated with scarlatina in children, occasionally call for operative interference. In this group, while bacteria may be present, there is, as a rule, an absence of foci of suppuration in the kidneys. When pus is present, such cases are perhaps better classified as surgical kidneys, whose treatment has been described in *Acute Miliary Abscesses of the Kidney*.

The removal of the capsule of the kidney is indicated in the extreme forms which have shown a high grade of albuminuria, often associated with rebellious anasarca passing over into the stage of anuria, and more especially, with asso-

ciated uremic symptoms. Such cases should be treated by decapsulation, first of one kidney, later of the other. When the above signs are present, and there is any evidence of suppuration, then both decapsulation and nephrotomy, for the purpose of draining the pelvis of the kidney, should be done.

PREPARATION FOR OPERATION.

In chronic cases patients are prepared for the operation by rest in bed for a few days or a week to lessen the eliminative work of the kidneys and to improve the heart, as well as to permit a careful preliminary examination of the urine and of the general physical condition. Further, the question of food and drink is regulated. The operation done is a nephro-capsulectomy or capsulectomy.

TECHNIQUE OF OPERATION.

Nitrous oxid and oxygen are used by pressure as an anesthetic, and the patient is put face down on an Edebohls cushion, this posture making both kidneys accessible. The usual incision is made from the last rib at the superior lumbar triangle down and out about three inches in length.

The oblique muscles are drawn aside, exposing the retroperitoneal fat, Gerota's capsule lying under the quadratus muscle is punctured, and the kidney exposed. The kidney is freed from its surrounding fat by a rapid, blunt dissection with the gloved index finger, and, if possible, lifted out of the wound without bruising it. A delicate incision is carefully made along the dorsum from end to end, only cutting through the capsule. It is sometimes easier to make the incision on a grooved director carried along under the capsule.

Each half of the capsule is gently stripped off the cortex and reflected back toward the hilum of the kidney "until the entire surface of the kidney lies raw and denuded before the operator" (Fig. 440). Care must be taken not to break or tear off bits of adherent inflated kidney substance with the capsule. Edebohls says: "I have found the smooth surface of the index finger of the rubber-gloved hand the best instrument for safely effecting the separation of the capsule proper from the kidney." The stripped-off capsule is then cut away entirely close to the hilum. When the kidney is high up, and only the lower pole can be reached, Edebohls has peeled off the entire capsule at a finger's length in the bottom of the wound and out of sight, and, when impossible to excise the capsule thus detached, has left it. Drainage, except in rare cases,

is not necessary. Both kidneys may be operated on at once to avoid giving an anesthetic twice. Dressings are then applied and the patient is put to bed.

FIG. 440.—DECAPSULATION OF THE KIDNEY FOR NEPHRITIS. The fatty capsule is drawn away from the kidney exposing the true capsule, through which an incision is made along the convex border of the kidney from pole to pole. The capsule is then stripped off with a dissector or the finger. This method was originally introduced by the late George H. Edebohl.

If there is much edema a protective drain should be inserted. Duration of the operation is from a half hour to one hour. The patient is kept in bed from two to three weeks.

RESULTS OF OPERATION.

The sequelæ of the operation showed marked improvement in the cardiovascular system, which forms the surest indication of progress toward recovery.

Cases in which the heart is simply hypertrophied are safe, but if there is any decided dilatation or aortic regurgitation, the operation ought not to be done. Nine cases, in which there was an albuminuric retinitis, all died within a year of the operation.

A. Pousson ("Chirurgie des Néphrites," Paris, 1909), who has written elaborately upon this subject, prefers nephrotomy with drainage, associated with antiseptic irrigations of the pelvis of the kidney, to decapsulation, and, further, does not claim to cure, but to ameliorate the disease, relegating the question of the curative surgical treatment to a consideration of Edebohls' claims and operation.

Although nearly fifteen years have elapsed since Edebohls' publication and the treatment is but little practiced, a careful perusal of his clinical records is still inspiring. Careful studies, both by animal experiments and human autopsy, have tended to show that there is no permanent betterment of the circulation. Undoubtedly the freeing of the capsule in the swollen kidneys of acute and chronic parenchymatous nephritis brings a temporary improvement and may tide the patient over a crisis. Our personal experience in three or four cases of chronic interstitial and chronic parenchymatous nephritis has not been such as to lead us to much hope in the method, although there has been no injurious effect. In one case of chronic parenchymatous nephritis the comparative functions of the two sides were carefully studied and then one kidney decapsulated. After the operation, by means of the functional tests, the two sides were studied for months and no improvement and no loss of function noted in the decapsulated kidney.

The entire subject is really in need of most searching investigation, based on more cases in individual hands, where uniformity in investigation can be practiced. Even to-day but little can be promised.

CHAPTER XXVII.

TRAUMATIC INJURY OF THE KIDNEY AND URETER.

INJURIES TO THE KIDNEY.

Although the kidneys seem to be well protected by their anatomical position deep in the loin under the thoracic arch, they are not infrequently injured by violence applied to the back or the abdominal walls in the form of a blow or crushing force, or by an extreme flexure of the body, or by severe muscular exertion alone. When both kidneys are injured other organs are usually seriously damaged at the same time. Out of 272 cases in Küster's collection, 142 occurred on the right, 118 on the left, and 12 on both sides. Injuries of the kidneys, without any solution in the continuity of the skin, are classified as subcutaneous, as well as those accompanied by an open wound due to a stab or a bullet.

Injury of the Kidney without an Opening in the Skin.—When the right kidney is injured there is often a fracture of the lower ribs and a coincident injury to the liver. Küster has noted fractures 14 times in 278 cases. A horse-shoe kidney has also been ruptured by the kick of a horse (Henry Morris, "Surgical Diseases of the Kidney and Ureter," 1901, 162). There is no marked difference in the frequency of rupture between the right and the left kidney (Frank).

Injuries may result in nothing more than a decapsulation with or without the kidney escaping from the rent. In other cases, due to the bending of the kidney across the last rib, the organ may be torn into an upper and lower half. Again, the fracture in the substance may be stellate, extending to both poles, or it may be so complete as to disorganize the kidney into a pulpy, jelly-like mass within its capsule. The pelvis of the kidney alone may be ruptured, or may be torn off from its ureter. In other instances the kidney has been severed from its vessels. Sometimes the overlying peritoneum is torn and the organ escapes into the abdominal cavity.

O. Hildebrand (*Beitr. z. klin. Chir.*, 1903, xxxvii, 782) reports 12 cases of rupture of the ureter, in two of which the renal pelvis was likewise torn.

The sequelæ of the ruptured kidney are: in the first place, acute symptoms

due to hemorrhage pouring out behind the peritoneum, often forming a tumor of considerable size, the hemorrhage sometimes taking place within the peritoneum; in the second place, suppuration, or the formation of a large abscess, due to the accumulation of blood mixed with urine in the loin.

Posner (*Centrlbl. f. inn. Med.*, 1906, xxvii, 307) distinguishes two late sequelæ of trauma of the kidney, one due to bacterial invasion, the other to the development of Bright's disease, which he considers frequent and likely to give rise to a similar affection on the opposite side.

Among the remoter sequelæ are hydronephrosis, pyonephrosis, perinephric abscess, cyst formations of the kidney, impervious ureter, stone in the kidney, and aneurysm. In Körte's list a subsequent movable kidney was noted, and in several cases a hard, indurated area persisted in the loin.

Neumann describes a case of ureteritis and cysto-pyelitis following a trauma complicated by a secondary gonorrheal infection. He also had another case in which traumata had re-

FIG. 441.—RUPTURE OF ANEURYSM BETWEEN LEAVES OF RENAL FATTY CAPSULE. The vast hematoma surrounds the kidney, spreading up and down, and following the funnel-shaped pocket of the renal fascia. (J. H. H. Autopsy No. 1640, Dec. 11, 1900.)

sulted in the formation of hydronephrosis, which became secondarily infected with gonorrhea. In one of his cases (*Centrlbl. f. Chir.*, 1906, xxx, 267), 6 years after injury, a nephrectomy showed a malignant papillary cystoma.

Symptoms.—The cardinal symptoms of rupture of the kidney are; shock and collapse, hematuria, evidence of internal hemor-

rhage, an increasing area of dullness or tenderness, formation of a tumor, often considerable in size (Figs. 441 and 442), elevation of temperature, peritoneal reaction, tympany, pain, nausea, simulating peritonitis, followed, it may be at a later date if absorption does not take place, by evidences of infection.

Shock and collapse are often present at once in severe cases, or may appear later with the evidences of internal hemorrhage. They are most marked in conjunction with extensive associated injuries. If the lesion is a slight one the patient may go about his business for a time, showing no signs of illness.

Hematuria, one of the most significant of all the signs of injury of the

kidney, nearly always appears within a few hours, though occasionally it may be delayed, as in a case of Körte's, where it appeared on the sixth day. The bleeding may appear intermittently. The amount is sometimes excessive, and the patient appears to pass large quantities of pure blood; at other times it is

FIG. 442.—RUPTURED ANEURYSM, AS IN LAST FIGURE, IN TRANSVERSE SECTION. The distribution of the blood corresponds to the distribution of all fluid accumulation in the renal fascia, such as a perirenal abscess or serous and bloody effusions following injury. The accumulation is in front of and behind the kidney, pressing also into the hilum and the sinus renalis.

slight, and only discoverable by the microscope, as when it follows the trauma involved in palpation of a movable kidney (Menge). After all evidences of hemorrhage have disappeared a spectroscopic examination may still show hemoglobin in the urine. Following hematuria, anuria has been observed leading to an operation on account of suspected rupture of the bladder.

Temporary suspension of the hemorrhage may be caused by the ureter becoming plugged by a blood clot, and when this is washed out, the hemorrhage begins again. It may also stop when the vessels are thrombosed, to reappear if the thrombus becomes dislodged. Maas observed hemorrhage in 65 out of 71 cases. Hematuria is absent in extensive and complete rupture of the kidney, as well as in the opposite condition, where the rupture is merely confined to

the capsule or the cortex. It is also wanting when there is complete detachment of the kidney from its ureter. Long after the blood disappears, the urine may show the presence of albumin and casts.

Internal Hemorrhage.—One of the most serious and striking symptoms connected with any extensive injury of the kidney is the evidence of an internal or retro- or intra-peritoneal hemorrhage, usually associated with more or less shock and collapse. It is important to distinguish between simple shock and collapse, from which the patient tends to recover quickly under stimulation and sustaining treatment, and the shock and collapse induced by increasing hemorrhage, when death may occur as the surgeon is supinely looking on.

The evidences of such increased hemorrhage are growing pallor, rapidity of pulse with diminishing volume, and an accumulation forming in the flank. The area of dullness is not affected by the posture of the patient. Above all, the evidence of a progressive diminution in the hemoglobin is easily demonstrated by any of the familiar instruments.

Areas of Tenderness or Dullness.—In the injured side these form one of the most striking symptoms of the renal injury, being present in all cases except where the shock is profound or where there are other grave or painful injuries for a time serving to obscure it.

Formation of Tumor.—A tumor of considerable size may be found in the loin. Körte in 39 cases found a tumor in 4, each as large as a man's head. In one it was oblong, following the course of the ureter. The average time for the disappearance of the tumor by absorption is 4 weeks.

Elevation of Temperature.—Elevation of temperature, due to absorption of the effusion of blood without infection, is one of the most characteristic signs of convalescence, the temperature often rising as high as 102° F. This febrile elevation must be carefully distinguished from that due to an infection. In the non-infective fever, the pulse remains slow and quiet, while the general appearance and the impression made by the condition of the patient are good. Judging by experiences with extrauterine pregnancy, there will be a leukocytosis and high differential count, so that these important diagnostic aids are of no service in distinguishing between the two conditions.

Peritonitis.—In many cases of kidney injured by trauma, in a pronouncedly brief interval of time, often within a single day, a markedly distended abdomen associated with muscular rigidity and vomiting give the surgeon grave fears of infection and peritonitis. These symptoms are confusing. In Körte's 39 cases peritonitis, however, was actually found only once. True peritoneal cases are usually associated with serious injuries of the liver as well as the kidney.

Diagnosis.—The diagnosis of injuries of the kidney is not difficult as a rule, although if the patient is in profound collapse it may take a day or two to get a very definite idea of the extent and character of the injuries. We have in these cases a condition of shock and the history of injury (occasionally there is no such history), and sometimes a contusion or ecchymosis in the loin, blood in the urine, and a marked tenderness in the loin, with or without an area of dullness, increasing in size. Associated with these is a subsequent elevation of temperature.

Let the patient, when brought into a hospital, be catheterized at once and the urine be examined. At a later date a cystoscopic examination may show at once which is the damaged side and the ureteral catheter may reveal the condition of the opposite side, a datum of importance in case of operative interference. The blood should be examined for anemia, the kidney region percussed for dullness and palpated for tenderness or tumor. The tumor may grow while under observation for several days. In some cases there is much blood in the urine and a marked amount of shock with pronounced peritoneal symptoms, conditions which may closely simulate rupture of the bladder. In one of Körte's cases he secured bloody urine by the catheter, but two hours later, finding complete anuria, suspected rupture of the bladder and made a suprapubic opening, which showed the bladder to be intact. In another instance, suspecting rupture of the bladder, on account of intense pain to the left of the organ, an incision was made which also revealed an intact organ. We believe that for the future, with these cases before us, it will be well, having everything ready, to proceed to the operation, trying first the injection of a warm, mildly antiseptic fluid into the bladder, running it in and out as in a vesical irrigation. If all the fluid is returned several times, suspicions of rupture may be dismissed. In event of an operation it is always a matter of comfort to the operator when the condition of the opposite kidney can be determined cystoscopically, for he has then the assurance that he is not operating upon a solitary kidney and, possibly, that the uninjured kidney is not diseased.

Treatment.—The treatment of rupture of the kidney has entered upon a new phase with the recent and better methods of anesthesia—gas and oxygen, or gas aided by the addition of a little ether. Formerly, say twenty years ago, the important question was whether a patient with reduced vitality could well stand the added risk of further reduction due to chloroform or ether anesthesia, and a more or less protracted, difficult operation. These risks were so pronounced that the waiting policy was, as a rule, adopted, except where the patient was evidently going from bad to worse. To-day an experienced surgeon with a skilled anesthetist ought to be able to tide his patient along safely

through an operation without appreciably lowering the vitality. Where the special surgeon and the skilled anesthetist are not available, the wisest policy is to wait and watch the patient. For the comfort of those who feel it wiser to wait, we quote the statistics of Alfred Frank and Körte's Clinic:

"In all our subcutaneous injuries of the kidneys, aside from those already infected and demanding operation for this reason, we had succeeded with a purely symptomatic treatment, that of resuscitatives in the beginning, with the strictest orders for rest in bed, using the icebag and morphia. When the hemorrhage persists, ergotin, adrenalin, and gelatin injections have been of good service. Later, to promote absorption of the exudate, electric sweat baths were used. The average treatment lasted four and one-half weeks, and not a single case was lost." (*Archiv f. klin. Chir.*, 1907, lxxxiii, 546.)

Körte operated twice on account of suspected rupture of the bladder, which did not exist; once for traumatic peritonitis where both liver and kidney were seriously injured, with death from collapse; once on account of a urinary phlegmon with death; once on account of rupture of the pelvis of the kidney with calculus and urinary phlegmon following, where a nephrectomy was done, and the patient recovered.

In other words, out of a series of 39 cases, 33, or 84.62 per cent., recovered, while 6, or 15.38 per cent., died. Expressed somewhat differently, out of 30 isolated ruptures of the kidney only one patient died.

Expectant treatment is recommended as long as there is profound shock, and the character and extent of the injury are uncertain. To this end absolute quiet and rest are enjoined. The bladder should be emptied, the urine carefully examined, and if there is any severe local pain, an icebag should be applied and hypodermics of morphia should be given to diminish pain and secure rest. With much bleeding and the bladder filling with clots, it may be necessary to wash it out, even using an evacuator or sometimes opening the bladder. If cystitis has developed in a later case, it is better to wash the bladder out frequently or to open it and let it drain.

As the patient begins to react, and as long as there is manifest improvement, the waiting and watching policy must be continued, keeping an eye at once on the local symptoms in the side, on the urine for hematuria, and on the apparent general conditions.

Should the patient show diminishing hemoglobin, it will be best to operate promptly upon the affected side, and if there is evident hemorrhage (as seen by the urine), with tension and the formation of a tumor and diminished hemoglobin, the side should be opened under gas, the blood clots cleared out, and the injury treated. A tumor may form in the side, but if the general con-

dition of the patient remains good we think it better to continue the waiting plan.

Let an operation be done as soon as there is elevation of temperature associated with quickening pulse and local tenderness—evidences of infection. It is important not to mistake simple elevation of temperature, due to the absorption of the blood, for an infection. The advantages of operation are:

1. It relieves uncertainty as to the future course of the case, transforming the obscure into the obvious.

2. The source of hemorrhage is discovered; the hemorrhage promptly controlled.

3. The early operation insures against later infection.

4. Such sequelæ as nephritis, hydronephritis, and aneurysm are prevented.

5. The entire kidney, or a part, may be saved by an early conservative operation.

6. Convalescence is greatly shortened.

7. Much suffering may be prevented, as the patient does not then experience the distress of clots plugging the ureter or filling the bladder.

The purpose of the operation is to clear out the blood clots; explore the kidney and its immediate surroundings; discover the source of hemorrhage with the character and extent of injury done to the organ; then, if possible, to repair the damage, or remove the damaged kidney together with the accumulated masses of blood. At a later step the operation aims at clearing out all dead tissue and providing for abundant, free drainage and removal of infectious material. It should be its aim also to discover and remedy as far as possible any complicating injuries to the kidney pelvis, fracture of the ribs, injury to the liver and bowel, and peritonitis.

The patient is put under gas and oxygen anesthesia, a hypodermic of strychnin is given, and, if the hemorrhage has been severe, a salt solution infusion is used. If there is any peritoneal reaction or doubt as to the conditions of the abdominal organs, the incision should be made so as to admit of the opening of the abdominal cavity in its anterior part. If no injury to the peritoneum is discovered this may be closed at once.

Where a mass of blood is found and cleared out, and there is no active hemorrhage, the wound should be packed and drained. By this means T. R. Neilson (*Am. J. Med. Sci.*, 1898, n. s., cxxxv, 54) had four cases with three recoveries. In two of these cases there were enormous tears of the kidney.

J. G. Andrew (*Lancet*, Lond., 1907, i, 213) had a case of traumatic rupture of the kidney, which he treated with the tampon and drain. On the occurrence of a secondary hemorrhage the kidney could not be extirpated, for he had

determined by laparotomy that the other kidney was absent. If a rent in the kidney is found, it may be sutured in this way, uniting the fractured organ and promoting repair. If the kidney is too extensively torn to continue its function, or if it is pulpified, it should be removed. Sometimes it will be possible to save a part, but if the ureter has been torn off, removal will be necessary in most cases.

Before removing one kidney the condition of the opposite organ should be ascertained. This can be done by injecting 10 c. c. of a 4 per cent. solution of indigo-carmin into the muscles at the beginning of the operation. Then on exposing the kidney the ureter can be shut off for a few minutes while the secretion is collecting from the opposite side from the bladder.

In rare cases both kidneys may be injured, as in a case reported by A. L. Franklin (*Am. J. Surg.*, 1906, xvi, 1-8). A girl 16 years old was run over by a wagon; intense pain, followed by vomiting and hemorrhage and a tumor appeared in the right side. As she was growing weaker an operation was done 18 hours after the injury. The abdomen was opened, the left kidney found torn to pieces, and the right one also ruptured. The left kidney was removed in its entirety and three-fifths of the right one taken out. Six months later the patient seemed well.

A stab or a gun-shot wound of the kidney demands active treatment when the symptoms are sufficient to indicate that the weapon or missile has reached and penetrated the kidney substance; that is, when there is hematuria or an accumulation in the lumbar region, or the general condition of the patient indicates a concealed hemorrhage.

In such cases expose and explore the kidney, together with the surrounding retroperitoneal space. A wound of the kidney structure itself may be treated by suturing its capsule or passing deep sutures through its structures, followed by a free drainage of the retroperitoneal space (A. B. Johnson, *Ann. Surg.*, 1907, xlv, 124).

INJURIES TO THE URETER.

The commonest trauma of the ureter is that produced, either intentionally or accidentally, during surgical operations, especially in operations for large tumors or malignant growths in the female pelvis. Such accidents are usually noted immediately, and can almost invariably be repaired. The general type of such traumata and their repair are shown in Figures 443 and 444.

The injury next in frequency is that associated with labor, which is usually accompanied by extensive injuries of the bladder. Such accidents may follow a

labor immediately or develop in a few weeks. Their nature and treatment are fully discussed in Chapter XXXIII.

In recent years, the extensive employment of the ureteral catheter and the use of injections of foreign substances have resulted in not a few injuries

FIG. 443.—OPERATIVE INJURY TO URETER, IN REMOVING LARGE CANCEROUS TUMOR OF OVARY. The ureter was so densely adherent to the growth that the piece shown in the figure was resected and removed with the tumor. For the purposes of uretero-vesico anastomosis, the small opening shown was made in the bladder, through which an instrument was introduced, by means of which the nearest point in the bladder was pushed up in a cone to meet the ureter. $\frac{1}{2}$ natural size. (Mrs. D., March 17, 1900.)

to the ureter. Almost every catheterization of the ureter produces a slight injury, as shown by the blood present in the urine. Occasionally rough or unskillful handling of the catheter, and especially of a stylet instrument, such as is employed in open-air cystoscopy, leads to a severe injury.

FIG. 444.—COMPLETED URETERO-VESICAL ANASTOMOSIS. After pulling the ureter down and displacing the bladder upward, the anastomosis was effected, after which the opening made in the vertex was closed.

We recently observed a case in which the operator had perforated the left ureter just as it left the true pelvis, and injected a large amount of collargol solution into the retroperitoneal tissue. Such an injury may be very serious, and in this case led to death from sloughing and infection.

A much rarer type of injury is that which results from external force without any surface wound. C. Blauel (*Beitr. z. klin. Chir.*, 1906, 1, 28) has carefully searched the entire literature and found but 12 cases. He points out that the deep position of the organ, its strong structure, and its comparative freedom of movement, all guard against injuries. In 5 of 12 cases the injury was occasioned by a wagon or a heavy weight passing over the abdomen; in only 2 cases by a violent traction on the body and resultant pull on the ureter. In 3 of the 12 cases there was death from infection or shock.

P. Wagner (*Centrlbl. f. d. Krank. d. Harn- u. Sex.-Org.*, 1896, vii, 1) has pointed out how often traumatic injury to the ureter results in hydronephrosis.

In some of these injuries there has been reflex anuria. In the fresh injury the diagnosis is generally most difficult. Usually there is no blood in the urine, as the side injured is cut off from the bladder. The appearance of a tumor immediately after the injury, especially when associated with anuria, is very suggestive. If the patient is not too much shocked, catheterization of the ureters and employment of the usual methods will help. Untreated, the death rate is very high. The proper course to pursue is immediate incision, with the possible repair of the ureter. When this is impossible, and the patient's general condition good, nephrectomy is indicated. When the patient's condition is bad the ureter should be brought out on the skin and the nephrectomy left for a second operation.

An occasional source of injury to the ureter is a penetrating bullet or stab wound. Morris ("Surgical Diseases of the Kidney and Ureter," 1901, ii, 332) reports 5 such cases from the literature. They are almost invariably associated with other injuries; the diagnosis rests on the escape of urine, and as the treatment will depend on the kind of injury to the ureter, as well as the associated injuries of other organs, it needs no special mention here.

CHAPTER XXVIII.

MALDEVELOPMENT OF THE KIDNEY AND URETER.

The development of the kidney from a topographical standpoint is a complicated process, the various steps in the growth of the parenchyma going hand in hand with many changes in the relative position of the entire organ. It is, therefore, not surprising that we find a great number of deviations from the normal in this portion of the urinary tract.

In the following description the classification of abnormalities as given by Küster ("Die chirurgischen Krankheiten der Nieren," 1. Hälfte, *Dtsch. Chirurgie*, 1896) will be followed and free reference is made to cases he has collected from the literature.

When meeting with an anomaly it is often difficult to explain its cause, since the disturbing factors are frequently unknown to us; all we observe are the results. In many cases, however, the knowledge of embryology permits a fairly accurate surmise.

The disturbance takes place either in a very early stage, in which case we would find the kidney insufficiently developed and even in the embryonic position; or, in the later stages, when we see the organ fully developed but of peculiar form, or in peculiar relationship to the neighboring structures and to the vascular centers especially. Renal malformations seldom prevent normal function, except when the minute structures are involved. Such malformations may become the origin of tumors and as such endanger life.

The forms of maldevelopment may be classified under three headings, viz.:

Maldevelopment I. As to Number.

II. As to Form.

III. As to Position.

MALDEVELOPMENT AS TO NUMBER.

While complete absence of both kidneys, as observed in monstrosities (acephalus and amencephalus) and other forms incapable of life, does not, of course, exist in the living, the absence of one kidney is by no means rare.

COMPLETE ABSENCE OF KIDNEY ON ONE SIDE.

To bring about this condition the disturbance must take place in the earliest stage of the renal anlage, i. e., during the third or fourth week of embryonic

FIG. 445.—SOLITARY ECTOPIC KIDNEY AND PELVIC ORGANS SEEN THROUGH A MEDIAN ABDOMINAL INCISION. Trendelenburg posture. There was no vagina and no uterus; the uterine appendages were in the inguinal rings, while the kidney was a solitary fused organ. (From THOS. S. CULLEN, *Ann. of Surg. Gyn. & Obst.*, 1910, xi, 74.)

life. The anlage of one of the two kidneys then either fails to bud from the Wolffian duct, which may itself be insufficiently developed, or the anlage passes through the first stage, but becomes arrested and absorbed before it has com-

pleted its ascent. The other kidney goes through the various stages of development and is then termed "solitary kidney," the "unsymmetrical kidney" of Morris.

This appearance may often be simulated by pathological conditions which cause one kidney to degenerate and almost or entirely disappear.

About 10 per cent. of the cases of complete absence of one kidney in Küster's collection were found in newborn babies. In them the condition is usually associated with other anomalies, such as imperforate anus, etc.

If the kidney fails to appear on one side there is, as might be supposed, partial or complete absence of the corresponding ureter and also, quite frequently, malformation or unilateral deficiency of the internal generative organs. Of these the conducting portions, vagina, uterus, and tubes in the female, and vas deferens and seminal vesicles in the male, are more often affected than the glandular organs, ovaries, and testicles. Absence of the corresponding adrenal body is less frequent.

L. Polack (*Thèse de Bordeaux*, 1909, No. 64) has brought together from the literature 264 case reports and carefully analyzed them. In 153 cases both kidney and ureter were absent; of this group 89 were left-sided, 56 right-sided, and 8 not stated. The kidney alone was completely absent 20 times. In 41 cases there was associated maldevelopment of the sexual organs. Such a condition is well shown in Figure 445. The associated adrenal was absent 25 times. A majority of the cases occur in males. W. F. Braasch (*Ann. Surg.*, 1912, lvi, 726) reports, out of 36 anomalies, absence of the kidney 6 times.

We have personally met with this anomaly in 3 cases. In one there was tuberculosis of the kidney, in another stone and hydronephrosis, and in a third stone and tuberculosis. All were suspected by examination failing to show the ureter on one side, and all proved by cutting down on both the kidneys at operation. In case 1, nothing beyond exploration was carried out; in case 2 and 3, stones were removed. Case 2 died of anuria 2 days after operation; case 3, in spite of the tuberculosis, lived more than a year.

The ureter of the single kidney may open into the opposite side of the bladder, or, more correctly expressed, the ascending kidney may cross the middle line and lodge in the lumbar region of the opposite side (Lyon-Caen and Marmier, *Bull. et mém. de la Soc. anat. de Par.*, 1907, lxxxii, 400).

The single kidney generally possesses an abnormal number of vessels, 3-5 arteries and 3-4 veins arising separately from the large abdominal trunks. The vessels on the side of the absent kidney are entirely missing; rarely one finds rudimentary or obliterated vessels. An unusual number of vascular twigs supplying the fat or connective tissue in the renal region points to the possi-

bility of there being rudiments of a kidney somewhere in the tissues, and if there is a number of large obliterated vessels, it may be considered as an indication that the kidney has existed and subsequently become destroyed by a pathological process.

The size of the single kidney is often much in excess of the usual dimensions, although it may not be above the average. This compensatory enlargement of the kidney is believed to have its cause, not in an increase in size of the individual glomeruli or tubules, as in compensatory hypertrophy of the remaining kidney after nephrectomy or disease; but in an increase in their number, i. e., hyperplasia of the individual constituents of the kidney, brought about during the fetal development.

INSUFFICIENT DEVELOPMENT OF ONE OF THE TWO KIDNEYS. CONGENITAL ATROPHY.

The rudimentary kidney is found in two groups: first, kidneys which develop from only a portion of the original anlage, and, second, kidneys showing the usual form and construction, though much reduced in size. The initial stage of these changes seems to occur in early fetal life. There is also usually a persistence of the fetal lobulation. The other kidney nearly always shows compensatory hypertrophy.

1. Between the complete absence of one kidney and the rudimentary kidney are many transition forms, all of which, however, show ureter and vessels, though often quite insignificant in development, or obliterated. The size of such a kidney varies from 2 to 5 cm. in length, and 1 to 3 cm. in width.

The rudimentary kidney may or may not have glomeruli and tubules; the pelvis and ureter are represented by a formless pouch at the end of a tube or a solid cord. The cortex may develop, but not to the extent of producing lobulation and subdivision of the medullary substance. We then find one solitary pyramid or perhaps two instead of the usual number. This would correspond to the embryonic stage found from the seventh to the ninth week.

2. A kidney of abnormally small size may possess normal structures throughout, but more frequently there are present atrophic conditions of considerable extent, so much so that practically the entire parenchyma consists of scar tissue. Such cases stand physiologically on the same level with complete absence of the kidney.

Whether these conditions are acquired or congenital can be determined by examination of the internal generative organs on the corresponding side. If the renal atrophy is of later origin the generative organs are usually unaffected.

It is obvious that in operations on such a kidney it is of the utmost importance to determine whether the other kidney is present, and, if so, whether it is functioning or not. The presence of an atrophic kidney on the supposedly sound side must lead to serious consequences. Cystoscopic examination, determining the absence or obliteration of the ureteral orifice, is the proper diagnostic means. An abnormally large kidney, with compensatory hypertrophy, would suggest an atrophic kidney on the other side. Careful study, however, is necessary lest the hypertrophy be mistaken for a pathological enlargement. Fortunately such cases of insufficient development of the kidneys are comparatively rare, and, according to Morris, it is found in only 0.02 per cent. of autopsies. Atrophy due to pathological causes, however, is more frequent, 0.72 per cent. of autopsies showing this condition.

W. F. Braasch (*loc. cit.*) noticed this atrophic condition 5 times out of 36 anomalies. Polack (*loc. cit.*), in a series of 264 anomalies, notes this condition 16 times. In one little girl he found the left kidney perfectly formed, but only about $\frac{1}{6}$ average size, and composed almost entirely of sclerotic-appearing glomeruli. This organ was not functioning; it was supplied with a ureter and was tuberculous.

It is quite common to find a kidney, in every other way normal, deficient in quantitative function as compared with the healthy fellow.

SUPERNUMERARY KIDNEYS.

Although from time to time cases have been recorded where more than two kidneys were said to have been present, it is doubtful whether the observations have always been correct. We know that there are kidneys which are divided by a horizontal cortical column into two entirely separate organs with separate ureters (partial or complete). Such kidneys have a deep transverse groove so marked as to awaken the idea that we have to deal with two kidneys on one side instead of one. Some horseshoe kidneys are so markedly lobulated as to resemble a semicircle of three or four separate kidneys, especially if more than two ureters are seen to leave the parenchyma. From the descriptions of supernumerary kidneys in the literature it appears very probable that the majority of them belong in this category.

A true case of supernumerary kidneys would be that in which the existence of more than two anlagen remaining separate throughout the entire process of development and ascent could be proven. Double ureters with double orifices in the bladder doubtless develop as separate offshoots from the Wolffian duct, but they are so close together that the kidney blastema surrounds the ureteral

ampullæ in one unbroken mass, which remains undivided during the entire period of the development; and in the adult we find kidneys with double ureters appearing as elongated organs, displaying merely a deep transverse groove in the middle, although this may also be lacking.

Supernumerary kidneys, as such, are, therefore, really not in existence, but appear as separate ureteral anlagen with parenchymal fusion of varying degree.

Watson Cheyne (*Lancet*, 1899, i, 215) has reported an unquestionable case observed at operation (laparotomy). The left kidney was in its normal place and was normal in size; the same condition was noted on the right side except that in addition to the normally placed kidney there was another 4 inches below it in the iliac fossa. Another case is that of Calabrèse (*Ann. d. mal. d. org. génito-urin.*, 1908, xxvi, 1841). For a most interesting review of the condition the reader is referred to Gérard (*Jour. de l'anat. et de la physiol.*, Par., 1905, xli, 241-267).

MALDEVELOPMENT AS TO FORM.

Such abnormalities are produced in the earliest stages of development in three ways: there is abnormal growth of the ureteral bud and corresponding abnormal arrangement of kidney blastema around the ureteral ampulla, affecting one or both kidneys separately and independently from one another; both kidneys, being normal in their individual anlage, unite with one another before they pass out of the pelvic position; or, both anlagen are abnormal regarding ureteral channel and form of kidney blastema, and fuse before they ascend.

The following are the most important representatives of these forms of maldevelopment:

THE LOBULATED FETAL KIDNEY.

While in the majority of kidneys the lobulation disappears to a certain extent after the fourth year, it may remain throughout life. The lobulation corresponds to pyramids or subdivision of such, the deepest grooves indicating pelvic divisions. The persistence of lobulation signifies one of two conditions; viz., (1) that the growth of the cortex during the postfetal stage did not take place vigorously enough to obliterate the depressions on the surface; or (2) that the cortical columns were of such depth that the usual postfetal cortical growth was insufficient to fill the grooves. Most lobulated kidneys have abnormal arterial circulation. The veins are more apt to be regular. Lobulated kidneys are more often found to be diseased than smooth kidneys, tuberculosis

being especially frequent. On the other hand a pathological process may accentuate the lobulated form.

THE HORSESHOE KIDNEY.

(*Ren Arcuatus S. Unguliformis.*)

Such kidneys are caused by fusion of the embryonic anlagen before their ascent out of the pelvis. Although the variations of this form of maldevelopment are great in number, they generally have the following features in common:

1. The fusion of the kidneys of the two sides takes place at their lower poles, because these are nearer each other than any other part of the kidney.

FIG. 446.—CORONAL SECTION OF HORSESHOE KIDNEY SHOWN IN NEXT FIGURE. The pelves are represented plastic. The two kidneys, from a secretory standpoint, are independent organs, the fusion of the cortex at the bridge being merely a narrow strip of fibrous tissue.

The time of fusion is at or previous to the seventh week of embryonic life (Fig. 461). The position of the kidneys at that stage corresponds to the position of the two halves of the horseshoe kidney in the adult.

2. The pelves of the horseshoe kidney are in front of the organ, because at the seventh week the kidneys have not rotated around their long axis (Fig. 461). There are frequently divided ureters, making the anlagen longer than usual, and when they enter into the position shown in Figure 461, their lower poles are nearer together than those of the shorter anlagen in a normal case, the mesoderm between them being reduced to a minimum.

3. The pelves do not fuse, because they are well developed, independent structures before the parenchymal fusion takes place.

4. The vessels of the horseshoe kidney are more numerous than usual, and arise from the nearest arterial source, usually at a lower level.

ry

FIG. 447.—HORSESHOE KIDNEY WITH AORTIC ANEURYSM. The aneurysm had been wired. The arterial supply was chiefly derived from one renal artery, arising in the median line. There are accessory vessels coming from the aorta near its bifurcation, and small branches from each common iliac. The bridge of the horseshoe kidney was found at the level of the aortic bifurcation. The renal pelves, as well as the ureters, are in front. (J. H. H. Autopsy, May 22, 1900.)

The bridge uniting the two halves of the horseshoe kidney prevents the ascent of the organ beyond the level of the aortic bifurcation. It is possible that the mesentery of the alimentary canal, together with the inferior mesenteric vessels, forms the main obstacle. At any rate, the horseshoe kidney does not swing back into the lumbar pockets, and the two halves do not rotate around their long axis, turning hilum and pelvis toward the aorta and vertebral column, as in the case of a normal kidney. As a consequence, the arterial branches enter the parenchyma mostly behind the pelvis. Thus in horseshoe kidneys we find the arteries coming from the aorta, either in one common trunk arising below the mesenteric arteries with several other smaller branches from the iliac arteries, or else, two separate trunks similar to the normal renal arteries only at a lower level. Besides these, however, there are nearly always smaller twigs coming from below and behind, derivations of the external iliac, internal iliac, etc.

As to the fusion itself, there are three degrees to be mentioned:

1. The connection may be a thin fibrous band without any trace of parenchyma in its interior (Fig. 446).

2. The bridge may be broad and consist of cortex alone, the medullary substance not participating in its formation. This is the most frequent form of horseshoe kidney (Fig. 447).

The bridge is situated at the aortic bifurcation and, while its posterior surface is smooth and flat, anteriorly it is lobulated and has a distinct depression in the middle.

There are six separate arteries supplying the renal parenchyma, all of which enter behind the pelves. The pelves are separate, their lower calices coming to within 5 cm. of each other. The bridge has a perpendicular zone of cortical substance in its middle, and this again appears divided by a septum into a right and a left half, making it evident that from the standpoint of secretion the two halves of this horseshoe kidney are independent organs. The horizontal axes of the two pelves are directed outward and back, the two rows of calices pointing, respectively, laterally and backward (Fig. 447).

FIG. 448.—UNILATERAL HORSESHOE KIDNEY. The left half is the larger. The ureter of the right kidney is seen to come from the bridge. (After Küster.)

3. The two fused kidneys may be of unequal size, and the bridge broad

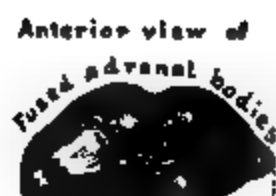
and thick, so as to make it seem a portion of the smaller kidney. The horseshoe kidney then presents an asymmetrical appearance on account of the distortions of the ureters and vessels associated with such forms (Fig. 448) (Marburg collection). While the left ureter is of the usual character found in horseshoe kidney, the right divides into three branches, one of which enters the small



FIG. 449.—HORSESHOE KIDNEY OF REMARKABLE TYPE. There are four distinct kidneys, the upper two lie in an approximately normal situation, with each hilum facing medianward; those of the two lower kidneys face downward and outward. Each kidney has a separate pelvis and ureter, the ureters on same side unite near the pelvic brim. The blood supply of this horseshoe kidney is complex, as shown in the diagram. (From R. B. Oleson, Chicago.)

kidney, while the other two go to the bridge. The bridge is thus designated as a portion of the smaller kidney. Its circulation, however, is derived from the branches of the larger kidney.

For the bridge to possess an independent ureter with a separate orifice in the bladder is quite rare. It is worthy of note that the orifice of the bridge ureter appears on the normal plane of the vesical trigonum, while the other ureter, though belonging to the higher renal segment, empties into an orifice below and medianward to the other. The same conditions exist as we shall see later in kidneys having double ureters. The upper renal pelvis corresponds to the lower vesical orifice, the lower pelvis to the upper orifice. The



F
b
a

FIG. 450.—HORSESHOE KIDNEY OF REMARKABLE TYPE. Instead of fusing at lower pole, the kidneys have become fused by the upper poles. The adrenal bodies are likewise fused into one. Associated with this anomaly, and probably the cause of it, was a hernia in the left anterior portion of the diaphragm, as well as a spina bifida. The aorta and the vena cava passed in front of the bridge of the horseshoe kidney. (From Max Broedel's collection of embryos.)

ureters are then usually seen to cross each other. A very complex form of horseshoe kidney is shown in Figure 449.

Horseshoe kidneys generally fuse below, but occasionally the upper poles may be united. Figure 450 is a drawing from a dissection of the abdominal viscera of a stillborn baby, whose kidneys had fused at their upper poles. The entire organ was situated in a capacious pocket behind the aorta and vena cava, and on top of the bridge was one large fused adrenal body. There was a spina bifida and an enormous diaphragmatic hernia on the left side. The large abdominal vessels were drawn considerably in a ventral direction, owing to the traction on the celiac axis and superior mesenteric artery, caused by the intestines lodged in the left pleural cavity. The hernial ring was situated in the dorsal half of the left dome of the diaphragm, and to it the intestines were firmly adherent. The space between the abdominal vascular trunks and the lumbar vertebræ was apparently sufficiently large to enable the kidneys to ascend in it. The fusion of the upper poles evidently took place after the kidneys had passed out of the pelvis.

FIG. 451.—UNILATERAL HORSESHOE KIDNEY. Both kidneys are on the left side of body and it is interesting to note how the circulation has adapted itself to the abnormal topographical condition of the kidney. The right renal pelvis is in front, one calyx coming from the bridge. (Path. Museum, J. H. H.)

According to the combined statistics of Morris and Socin, the horseshoe kidney occurs in 0.08 per cent. of cases. The statistics furnished by these two authors together cover almost 16,000 autopsy records.

The other three forms of fusion to be described below occur still more rarely, in fact they are of extreme rarity, Morris having found only 1 case in 8,178 autopsies. These are: the unilateral elongated kidney (*ren elongatus*), the scutiform or shield-shaped kidney (*ren scutaneus*), and the lump kidney (*ren informis*).

UNILATERAL ELONGATED KIDNEY.

(Ren Elongatus.)

This is a form in which both kidney anlagen fuse and ascend together into one lumbar pocket. It consists, then, of two superimposed kidneys, the bridge connecting them being formed by functioning renal parenchyma.

The two principal forms are:

FIG. 452.—TWO CASES OF SIGMOID KIDNEY. The hilum of the lower faces in the opposite direction from that of the upper kidney. (The right figure is from M. C. Winternitz, *Johns Hop. Hosp. Bull.*, 1908, xix, 229; the left after Küster.)

1. Simple elongated kidney (*ren elongatus simplex*).—The kidneys are one on top of the other, each hilum being turned toward the vertebral column. The arteries of both kidneys arise separately from the aorta, the veins accompanying the arteries. The ureters and pelves are separate, the upper passing in front of the vessels of the lower kidney without crossing the lower ureter. It then passes obliquely across the pelvis to the other side of the bladder to empty in the usual manner. It has, however, also been observed to open into the bladder on the same side. It seems probable that such cases are

nothing but kidneys with double pelvis and double ureter, where the other kidney has failed to develop. Unilateral elongated kidneys are very long and narrow, their pelves being mostly on the anterior surface (Fig. 451). They apparently are instances where the six-weeks' embryonic stage persists. The two anlagen ascended not side by side, but one on top of the other, in which position they became fused.

2. Sigmoid kidney (*ren sigmoideus*) (Fig. 452).—Brösike observed a case where the left kidney was in its normal place, with the hilum in its usual position; the other kidney, however, was on the same side just beneath the left, its hilum facing the other way. There was an oblique groove where the two kidneys had fused, in which was seen passing the ureter of the upper kidney. The ureter of the lower kidney crossed the sacrum and ran to the right side of the vesical trigonum. The vessels were separate, the upper having the usual arrangement, while the lower renal artery had a common origin with the inferior mesenteric. There was an accessory renal artery passing from the left common iliac to the caudal parenchyma of the lower kidney.

The ureters in sigmoid kidneys may cross each other, in which case the crossing takes place in the upper pelvic region or in the vicinity of the iliac vessels.

SCUTIFORM OR SHIELD-SHAPED KIDNEY.

(*Ren Scutaneus*.)

In this type, also, the fusion of both organs takes place very early, certainly before the kidneys have passed out of the pelvic stage, which corresponds to the age of four to six weeks. The fusion is extensive, involving the entire length of the kidneys, so that the result is a round, flat organ whose sides appear more or less lobulated. Such kidneys are found in low position and generally in the midline of the body, the sacral hollow being the favorite location. The scutiform kidney usually possesses two ureters, rarely only one. There are two principal types, a round and a flat:

1. The round form resembles a horseshoe kidney fused all the way up. In the central portion of the anterior surface are two depressions from which the ureters arise and into which the vessels plunge.

2. The flat form appears to be more frequent. The ureters are on the anterior surface, while the vessels enter and leave the kidney from behind. The kidney shows marked lobulation.

There are also unilateral scutiform kidneys, which are found in a low

position; the renal pelvis is in front, while the vessels enter from behind or from the sides, coming from the iliac arteries.

LUMP KIDNEY.

(Ren informis.)

Lump-kidney (Fig. 453) is, as the name signifies, an irregular, shapeless mass, composed of lobules of different size. Its position is described as being just above the sacral promontory. The ureters, 1 to 4 in number, are

FIG. 453.—LUMP KIDNEY (SO-CALLED). This represents an extreme degree of fusion of the primary depots. The two renal pelves are in front, as is common in all such anomalies. The blood supply is derived from the nearest points of the aorta and its branches. (After Küster.)

short and are most commonly situated on the anterior surface; the vessels are seen near the upper margin of the organ, but may also be on the anterior as well as the posterior surface. They enter the parenchyma in the depressions between the lobules.

MALDEVELOPMENT AS TO POSITION.

While abnormal position is noted with special frequency in kidneys of abnormal form, such as described above, it is by no means exceptional to find a

kidney of normal development in an unusual position. Still, it appears that the same factors which prevented the kidney from reaching its normal position generally caused also a disturbance of its form. This disturbance may be slight or severe.

Abnormal position of one or both kidneys may, of course, be produced by pathological influences, such as tumors, nephroptosis, etc., in which instances the examination of the length and course of the ureter may be of value in determining whether the descensus is congenital or acquired. In congenital low kidneys the ureter is shorter and free from kinks and twists, its length being determined by the level at which the kidney has become fixed, while acquired low kidneys have long and convoluted ureters. Furthermore, the vessels of kidneys of acquired low position are much lengthened, while in congenital forms they are short. In the following discussion reference will be made only to congenitally displaced kidneys.

4
5.

The factors causing the disturbance are conceded to be chiefly of a mechanical character, for it is evident that two kidneys fused cannot pass through the mesentery and its vessels and attain the level reached by separate kidneys. Fused kidneys therefore remain arrested either just above the sacral promontory, or in front of the lower lumbar vertebræ. In the case of an "elongated" kidney the two kidneys slide one on top of the other into the same lumbar pocket, the lower kidney coming to lie in the iliac fossa or in front of the iliac vessels. If one of the two kidneys fails to ascend, it is usually found at the brim of the pelvis or below, filling the sacral hollow. The renal pelvis is seen in front, and the shape of the kidney is altered to fit the bed in which it lies, flattened posteriorly and with deep anterior grooves. The vascularization is also abnormal. Figure 455 shows a right kidney which was found in the sacral hollow. Figure 456 shows a kidney which was found at a somewhat higher level.

FIG. 454.—ECTOPIC KIDNEY ON LEFT SIDE, WITH A NORMAL RIGHT KIDNEY. It is interesting to note the origin of the upper renal artery of the ectopic kidney, which, in its origin and course, resembles one of the arteries of the Wolffian body in the fetus. (From Path. Collection, J. H. H.)

A kidney in low position may easily be mistaken for a tumor, especially in

the female, and if, in the case of a pregnant woman, it is situated in the sacral hollow, it may become an obstacle to birth.

The kidney has been found in several peculiar positions, viz., near the



Same, showing pelvis and calices

FIG. 455.—ECTOPIC LEFT KIDNEY WITH ABNORMAL INTERNAL GENERATIVE ORGANS. In the upper picture the position of the kidney is indicated in dotted lines; also the short ureter leading to the anterior renal pelvis. In the lower pictures, an anterior view of the kidney and of the pelvis and its ramifications in the parenchyma are given. $\frac{1}{2}$ natural size. (S., J. H. H., April 8, 1905.)

inguinal ring, where it had interfered with the descent of the testicle; in a congenital umbilical hernia, etc.

A long single kidney with double pelvis and ureter is generally in normal position, though, on account of the greater length of the organ, the lower pole may extend into the iliac fossa and even below.




FIG. 456.—AN UNUSUAL ABDOMINAL TUMOR SHAPED LIKE A KIDNEY, SITUATED IN THE MIDDLE LINE. The tumor is embedded in and adherent to the omentum and small intestine at its hilum, with hard-feeling nodules, suggesting stones. The whole picture so closely resembled a misplaced kidney that, for a while during the operation, considerable doubt existed as to its nature. On opening the omentum, as shown, a dilated tortuous thrombosed vein was exposed. Examination, after removal, showed that the tumor was a parasitic myoma, undergoing necrotic degeneration. (From Edward S. Richardson, *Surg., Gyn. and Obst.*, Sept., 1910.)

Braasch, in his 36 cases, found 4 of ectopic kidney. We have observed 8 cases of ectopic kidney, 6 right-sided and 2 left-sided. In one of the left-sided cases (a colored woman at the Cambridge Hospital, Maryland), pregnancy had twice been successfully carried to full term labor in spite of the kidney, which was discovered accidentally during a laparotomy. None of these

FIG. 457.—SECTION OF TUMOR SHOWN IN PREVIOUS FIGURE. The hemorrhagic infiltration of the degenerated myoma, gives it the color of renal parenchyma. The coiled arrangement of the lighter areas suggests kidney cortex. This arrangement is probably due to a collapse of the walls of the necrotic myoma.

kidneys gave any symptoms except one in the right iliac fossa, which contained a stone, which was successfully removed. An interesting parasitic uterine fibroid simulating ectopic kidney is shown in Figures 456 and 457.

The Arrangement of the Vascularization in Abnormally Situated Kidneys.—The arteries always adjust themselves to the position of the kidney. They arise from the nearest aortic source. In extremely low positions they come from the common iliac, external iliac, crural, etc. It may even occur that the caudal artery may step into the service of a kidney which has not passed beyond the pelvic stage. Fused kidneys may have one large common artery arising from the front of the aorta above, from the inferior mesenteric, and usually

there are several accessory branches coming from below. If the kidney lodges in front of the aorta the majority of the vessels enter its parenchyma from behind or from above.

EMBRYOLOGICAL NOTES ON THE MALDEVELOPMENT OF THE URETER AND RENAL PELVIS.

The ureter arises as a process from the hind wall of the lower end of the Wolffian duct. Its distal end divides into two branches, which grow into the developing kidney blastema. Each branch divides again dichotomously. This

process is repeated until the calices and straight uriniferous tubules are produced. At first the ureter opens into the lower end of the Wolffian duct, but later the common piece is drawn more and more into the sinus urogenitalis, until finally Wolffian duct and ureter open separately into that cavity. The kidneys ascend into the lumbar region, causing the lengthening of the ureteral tube.

Fetal K.

Adult K.

FIG. 458.—DIVISION OF RENAL PELVIS

INTO UPPER AND LOWER BRANCHES.

The division is caused by an especially deep column of cortical substance (a), which has forced its way almost to the hilum. After the kidney has unfolded itself, as shown in the figure to the right, the pelvis becomes an extra-renal organ, appearing at the hilum as a divided pelvis, thus simulating cases of precocious branching of the ureter during the embryonic stage.

From the Wolffian duct in the male are developed the head of the epididymis, the vas deferens, the seminal vesicle, the ductus ejaculatorius; while in the female this canal exists only in rudimentary form as Gartner's duct.

1. If the Wolffian duct and ureter fail to shift anteriorly from the cloaca before the urorectal septum grows down to divide the rectum from the bladder, the ureter opens into the rectum.

2. If the ureter does not separate itself from the Wolffian duct but accompanies that canal in its journey caudalward, there results abnormal connection of the ureter with those organs which arise from the Wolffian duct (in the male, vas deferens, seminal vesicle, and ductus ejaculatorius; in the female, Gartner's duct).

3. If the ureter does not remain isolated from the Müllerian duct, it is attached in women to the uterus or to the vagina.

4. If the ureter, after the sixth week of embryonic life, does not become

detached from the Wolffian duct but accompanies that canal in its downward course, then the ureteral opening may be found in the sinus urogenitalis and the organs developing out of this, i. e., in the upper portion of the urethra in both sexes and in the vestibule of the vagina in women.

5. If the ureter separates from the Wolffian duct without opening into any cavity it becomes a blind canal with an atrophic or cystic kidney above.

Several theories have been advanced explaining the doubling of the ureter, the most important being as follows:

1. Sappey. The ureteral anlage, instead of branching near the kidney blastema, branches sooner, thus forming a bifurcated ureter.

2. Caudmont. The condition is brought about by a partial fusing together of two kidneys.

3. Deubierre. There is a double evagination from the Wolffian duct.

The first and third views are the more acceptable, although the first alone suffices to explain all the various phenomena. As long as the actual process in embryos has not been observed, the question, of course, can not be definitely answered; nevertheless, if we bear in mind the fact that the division of the ureter into two branches has been observed at any place between bladder and kidney, and that, if entirely separate, the two ureteral orifices are either close together or more apart, we must come to the conclusion that these transitions are all manifestations of one and the same factor, only differing in degree. No one will doubt that a ureter, double from the middle of its course up to the kidney, must have developed through a precocious branching of the original evagination before the ampullæ become embedded in the nephrogenic tissue (Figs. 458 and 460). The same may safely be assumed to have taken place in those cases where the division is found nearer the bladder or even at the bladder. The division of the original ureteral bud must then have taken place just after that canal branched off from the Wolffian duct. Another plausible explanation of the varying location of the point of division may be the surmise that the lengthening of the embryonic ureter may take place unequally in its various portions; viz., if the distal or divided portion stretches while the proximal or undivided remains more or less anchored close to the bladder, the place of division will be found far down. If the lengthening is more uniform in character, the place of division is found at a higher level. In Figure 459, g and h, the ureters were double from the brim of the pelvis up. In n (on the right side) they divide just outside the bladder, while in i, k, l, m, and n, on the left, they are separate throughout their entire course.

Such double ureters apparently either have their origin, as has already been indicated, and as we are inclined to believe, in two separate evagina-

FIG. 459.—DIAGRAMS FROM ACTUAL CASES, SHOWING ANOMALIES OF URETERS AND RENAL PELVES. Above are cases where the ureter branches to form two separate pelves, just before entering the kidney. In the next row, the division takes place further down, until both ureters are separate in their entire course; the vesical orifices are close together or further apart, the lower one even reaching the urethra. In the third and fourth row the ureter branches outside the hilum at the point of first division into two, three, four, five and even six separate calices, with or without the formation of a pelvis.

tions from the Wolffian duct, or the division of the single bud was so near the Wolffian duct as to appear as two separate outgrowths (Figs. 460 and 461). At any rate, the process must date back to the third or fourth week of embryonic life, i. e., before the common duct (portion of Wolffian duct between kidney bud and urogenital sinus) becomes widened and drawn into the sinus. While the lower portion of the Wolffian duct is thus utilized in the promotion of the growth of the lateral portion of the urogenital sinus, the posterior wall of the urogenital sinus grows vigorously in a downward direction, carrying with it

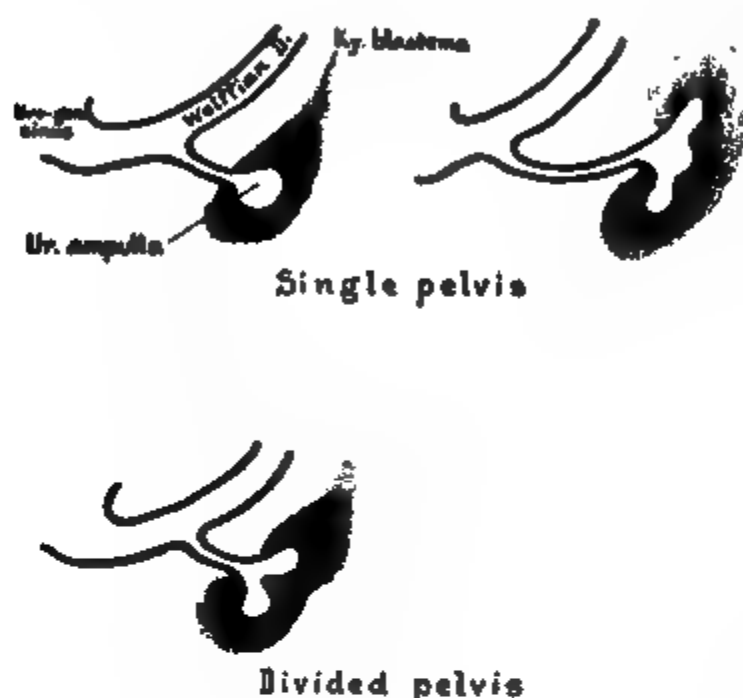


FIG. 460.—DIAGRAMS ILLUSTRATING THE ORIGIN OF A DIVIDED RENAL PELVIS AS COMPARED WITH THAT OF A SINGLE PELVIS.

usually in the place where the normal single ureter is found, while the upper continues its downward shifting together with the Wolffian duct mesially to the first attached ureter, until it also reaches the urogenital sinus. The Wolffian duct, minus the ureters, continues to shift to a still lower level. If the two ureters are liberated in quick succession they will be found close together in the bladder; if a longer interval prevails they are farther apart, so far that the upper ureter may be carried even to or below the internal urethral orifice.

The process is comprehensively shown in the diagrams of Figure 461. The pictures also make it clear why the ureters cross each other and why the ureter coming from the upper part of the kidney has a vesical orifice below and medianward to the orifice of the ureter coming from the lower part of the kidney. Figures 462 and 463 show a case of double ureter in an adult.

the orifice of the Wolffian duct. The orifice is thus caused to travel downward and medianward until it becomes permanently situated in the urethra in the male, while in the female the Wolffian duct continues to travel lateral to the Müllerian duct (vagina) down to the outlet (obliterated Gartner's duct).

During this process of expansion and simultaneous downgrowth of the Wolffian common duct, the ureters are thrown off in order to become attached to the bladder along the line marked by the travel of the Wolffian duct. The lower ureter reaches the bladder first (Fig. 461),

MALFORMATION OF RENAL PELVIS AND URETER OF LESSER DEGREE.

Besides these striking malformations just described there is a vast number of minor degree, many of which do not become recognized until a careful examination has been made. These concern more the upper part of the ureter and its branches, the calices. Since they are of great importance in surgery they have been taken up more fully in Chapter IV. In the light of embryological knowledge, however, they are also of considerable interest.

1. **Malformation as to Position.**—While the usual place for the renal pelvis is on the mesio-posterior region of the hilum, it is by no means always found in that position. We know that the kidney rotates around its long axis during the ascent out of the pelvis, and at the eighth week of embryonic life it has completed this rotation (Fig. 455). Insufficient rotation or a failure to rotate leaves the renal pelvis in a mesial or even anterior position. Such forms are pictured in Figure 455 and Figure 459, t-w. The greater number of vessels then enter the kidney from behind.

As a rule, the pelvis enters the hilum in the middle third of the kidney or just below; in cases of especially long kidneys, however, the pelvis may run along the entire length of the organ, giving off several major calices in more or less regular intervals. Such forms are probably due to precocious divisions of the ureter.

The pelvis enters the kidney sometimes very near the lower pole, and it seems as though this condition is brought about by a more vigorous development of the cranial half of the nephrogenic tissue and of the invading ureteral branches.

The position and length of the ureter are dependent upon the position of the kidney. A kidney in congenital low position has a short, straight ureter and a ventral renal pelvis, which is a persistence of the sixth-week stage.

2. **As to Form.**—The usual arrangement of the upper end of the urinary tract is a single pelvis at the posterior site of the hilum. This pelvis may be intrarenal, but is usually extrarenal. It follows that the division into major calices may be found either within the sinus renalis, just outside the hilum, or some distance from it. The number of calices varies between 2 and 6. In Figure 459 is pictured a series of abnormal forms of pelvis and ureter, which serves to illustrate the great diversity which is found in the form of the upper end of the urinary tract.

The ureter frequently divides into two branches before entering the hilum

FIG. 461.—FOUR DIAGRAMS ILLUSTRATING THE DEVELOPMENT OF A KIDNEY WITH DIVIDED PELVIS AND DOUBLE URETER. The figure shows why the ureters cross and why the upper pelvis and ureter drain into the lower vesical orifice, while the lower pelvis and ureter drain into the upper vesical orifice.

I. The double ureter starts from the Wolffian duct either (a) as two separate anlagen, (b) and (c), or as an original single anlage showing a precocious branching which resembles a double anlage.

II. Through expansion of the lateral portion of the allantois, the lower Wolffian duct becomes dilated and the lower ureter (c) is the first to reach the allantois. The Wolffian duct (a), carrying the upper ureter (b) with it, shifts with the urogenital sinus, in a downward direction, between the allantois and the rectum, as shown by arrows, until the second ureter (b) also becomes implanted in the bladder, but further down and more mesially than the first (c).

III. We here see a continuation of the same process of advance of the Wolffian duct with a greater separation of the duct from the ureter.

IV. The Wolffian duct continues to travel downward with the advance of the urogenital sinus and finally becomes permanently lodged at the neck of the bladder (a), in the male; in the female, it continues still further down. This last picture represents the final arrangement, as seen in the adult. Note that the original order a, b, c, as shown in first picture, is now reversed to c, b, a, at the bladder.

(Fig. 459, a-n). The lower division is generally the larger, and may not infrequently become distended to form an actual pelvis, while the upper division remains small and appears like the continuation of the ureter (Fig. 459). A division in 3 branches is seen in o-s. This appearance is sometimes simulated by the first form, i. e., division into 2 branches, if 1 branch divides again before entering the hilum. The lower branch is known to do this oftener than the upper. Division in 4 branches is shown in t-v, w has 5, while x has 6 well developed calices. Such numerous divisions are often seen in horseshoe kidneys and other fused forms; the individual branches then invade the parenchyma in many places and often considerable distances apart from each other.

In these cases of ureteral division outside the hilum, including the double ureters, an actual pelvis is often lacking, although the point of division may be marked by a dilatation of the ureteral lumen (Fig. 459, a and f).

These forms of ureteral division outside the hilum may have their origin in a twofold manner:

1. Through a precocious branching of the ureter similar to that producing a double ureter, only the division is quite near the kidney anlage. (See Fig. 459.) Through this the more pronounced forms are produced.

2. Through especially deep ingrowth of one or several transverse cortical columns during the fetal stages and subsequent unfolding of the adult kidney, by means of which mechanical process the pelvic divisions become dislodged downward and appear at the hilum. Figure 77 illustrates this influence of the cortex upon the shape of the pelvis, and it seems as though in this manner the majority of divided pelves of mild degree are produced.

In examining embryonic kidneys after the second month a transverse cortical column is often seen extending across the entire kidney and projecting far into the sinus renalis. This wedge of tissue divides the ureteral branches into two main bundles and the pelvis into two main branches. After the kidney has unfolded itself in the adult, the site of division becomes dislodged to a lower level and appears well outside the hilum.

If there are two or more cortical wedges growing into the ureteral branches the division of the pelvis may be into three or more calices.

Ureteral divisions and divided pelves outside the hilum occur, according to our experience, in about 28 per cent. of cases, and since the surgical significance of that condition is of considerable importance, a careful inspection of the kidney and its pelvis at the site of the hilum should be made before every nephrotomy.

Barring pathological conditions, the pelvis is more capacious if the divisions are inside the hilum and if the major calices are short. The cubic contents of such pelves vary between 10 and 20 c. c.

The branching forms, with long, narrow calices and without the formation of a definite pelvis, hold only 3-10 c. c.

FIG. 462.—AN ACTUAL CASE OF DOUBLE PELVIS AND DOUBLE URETER, REPRESENTING THE MOST USUAL TYPE. The distance between the vesical orifice is a short one, but this is a very variable factor. The crossing of the ureters is shown in a little diagram to the right.

Until quite recently, so far as surgery is concerned, the anomalies of the kidney and upper ureter were regarded as merely accidental and usually unimportant findings. As a rule, unless some pathological process sets in, these kidneys give no symptoms. Rovsing (*Ztschr. f. Urol.*, 1911, v, 586) has reported 3 symmetrical horseshoe kidneys which caused pain by pressure on the nerve roots. The treatment for this condition is simple division of the bridge connecting the halves. On the question of pathological processes in an anomalous organ too much information can not be acquired. Here the careful urological examination with the collargol injection is indispensable and leads to definite conclusions.

A splendid consideration of the surgical possibilities is to be found in the paper of Dr. Charles Mayo (*Ann. Surg.*, 1913, lvii, 511).

In many sections of this work the question of the confusions in diagnosis, due to double ureter and pelvis, has been dealt with, and it need not be considered here. The usual arrangement is shown in Figures 462 and 463.

One other interesting and important group of abnormalities remains—that of the opening of ureters outside the bladder.

FIG. 463.—KIDNEY WITH DOUBLE URETER AND TWO OPENINGS INTO BLADDER. The bladder is shown in sagittal section, with a speculum introduced into the urethra. The lower orifice, almost at the neck of the bladder, leads to the upper pelvis; it is also nearer the middle line. The other orifice is in its normal position and usually corresponds to that of the opposite ureter.

URETERS (SINGLE AND SUPERNUMERARY) WITH ABNORMAL ORIFICES.

It is about this class of anomaly that interest should center, as sometimes in these cases a diagnosis can be made *intra vitam* and, if made, may result in operation and permanent cure.

The symptomatology of this condition is, of course, extremely varied, depending on various factors, the position of the orifice being, of course, the most important. The most characteristic symptom of a great many of these cases is a peculiar variety of incontinence, that is, a constant dribbling of urine, associated with voiding from the bladder of larger quantities of urine from time to time. If this is the case, a careful cystoscopic examination of the bladder should be made, together with a thorough scrutiny of the external genitals, to determine the site of the abnormal orifice, if it should exist. If it is found, its exact position should be definitely determined, and, with catheters and bougies, we should ascertain the length and direction of the canal which ends at this orifice, whether it leads from the kidney region, whether the fluid flowing from it is or is not urine, whether the canal is uniform in caliber or sacculated, and whether it is in communication with the bladder, which last may be easily determined by injecting milk or colored fluids into the orifice and seeing if the urine flowing from the bladder is affected, and *vice versa*. Of course the ureteral orifices should be carefully searched for in the bladder, to determine whether the abnormal orifice is of a single or of a supernumerary ureter.

The fluid from the abnormal orifice should be carefully measured so that the daily capacity may be known, and it should be carefully examined for pus, as the location of some of these abnormal openings is such as to render infection extremely easy.

One should determine as well as possible whether the canal which opens at the abnormal orifice is at all constricted in its course by formations encroaching on its lumen, by peculiar twists or angles in its course, or, what is most common, by passing through muscular tissue which may narrow, or even for a time close the lumen and thus cause a light grade of stenosis. Such stenosis, of course, results in hydroureter and hydronephrosis, of greater or less extent, according to the position and extent of the obstruction; in some cases this is so great as to form an appreciable tumor, and in many cases it results in more or less complete atrophy of the kidney substance.

Of course all the above points can be determined in comparatively few cases, as in many instances the peculiar variety of incontinence mentioned above, which is usually the sole symptom that calls our attention to the condition, is wanting, and it is only at autopsy that the condition is determined.

These abnormal openings may be either of a single or of a supernumerary ureter, and may occur, of course, in either the male or female sex.

For convenience we have divided and subdivided these anomalies as follows:

- I. In the male genito-urinary apparatus.
 1. In the bladder.
 2. In the urethra.
 3. In the seminal vesicle, vas deferens and ductus ejaculatorius.
- II. In the female genito-urinary apparatus.
 1. In the urethra.
 2. In the vagina.
 3. In the vestibule of the vagina.
 4. In Gartner's canal.
 5. In the uterus or tubes.
- III. In the bowel.
 1. In the rectum and cloaca.
 2. In the intestines.
 3. In the urachus and amniotic cavity.
- IV. In case of congenital absence of the bladder.
 1. In the urethra.
 2. In the vestibule of the vagina.
- V. Blind endings.

The limits of our space make it necessary for us to consider only the more ordinary conditions found in the female.

OPENINGS WITHIN THE FEMALE UROGENITAL APPARATUS.

This is the subdivision of this subject which, of course, appeals to us much more than either double ureter or abnormal openings of the male ureter, for, besides the fact that we are devoting ourselves mainly to the urinary disorders of women, this abnormality, in contradistinction to the other two just mentioned, should be diagnosed during life and the condition entirely cured by operation.

The symptoms, namely, the peculiar form of urinary incontinence and the concomitant skin affections in the region of the vulva, as well as the dangers of infection, and the utter misery which many of the women suffering with these abnormalities must endure unless relieved by operation, warrant us in going into these conditions in detail.

The abnormal openings of the female ureter hitherto reported, consist of openings into the urethra, the vagina, the vestibule of the vagina, Gartner's canal, and the uterus and tube. A moment's consideration will show that in almost all of these that most unpleasant symptom—constant dribbling of urine—will be present if the kidney is capable of secreting, and this should call

our especial attention to the case and cause us to make a very careful examination of the genitalia, urethra, and bladder.

If the diagnosis is made correctly, an operation may be performed and complete relief obtained; if a wrong diagnosis is made and an operation attempted the patient will probably die of infection or uremia due to closure of the canal, from a wrong interpretation of the symptoms, while if the diagnosis is not made, the patient, living in a state of constant wretchedness, is always exposed to the dangers of infection, pyonephrosis, and death.

Opening of the Ureter into the Female Urethra.—Although but few cases of this anomaly have been reported, they are, nevertheless, of much greater significance than the corresponding condition in the male, as, owing to the short urethra and the consequent greater tendency of the anomalous ureter to open below the sphincter, urinary incontinence may occur and the case be recognized during life.

(A) OF THE SINGLE URETER.—One such case has been reported by Thilow. The case was that of an old woman who had constantly suffered from involuntary passage of urine, and at autopsy it was found that the right ureter passed by the bladder and opened into the urethra.

(B) OF A SUPERNUMERARY URETER.—Cases of this kind have been reported by Erlach, Kolisko, Tauffer and Velits, and Obici.

In Erlach's case the woman died of thrombosis of the right spermatic vein, and the autopsy showed that the right kidney had two pelves and two ureters, one ureter opening in the normal place, the other (the lower) passing below the sphincter and opening directly into the urethra, being markedly dilated just above the orifice. Although this ureter opened below the vesical sphincter there was urinary continence.

Kolisko's observation was made at autopsy on a woman 21 years old, who had died of endometritis following pregnancy, and had never had any urinary symptoms. The autopsy showed a normal kidney and ureter on the left side, while on the right side the kidney had two distinct pelves, from the lower of which ran a ureter of normal size opening in the usual place in the bladder, while from the upper, which was markedly dilated, ran a widened ureter opening into the urethra just below the internal urethral orifice, after forming a cyst-like dilatation in its course beneath the vesical mucosa; when filled with fluid this cyst would completely close the urethral orifice. The portion of kidney corresponding to this ureter was much atrophied and had but little secreting substance.

The case of Tauffer and Velits is of great interest from the fact that the condition was recognized and an operation performed, with a perfect result.

The patient was a 14-year-old girl who, since birth, had suffered from constant dribbling of urine. A cystoscopic examination showed that both ureteral openings were normally situated in the bladder, and that there was no evidence of any communication between the two ureters on the left side. On the left side of the posterior wall of the urethra an opening was seen, through which a ureteral catheter could be introduced backward and to the left for quite a distance, and through which urine flowed. Tauffer performed epicystotomy, introduced a knobbed sound into the third ureter, pressed the knobbed end toward the bladder cavity at the level of the normal left ureteral opening, cut down upon the sound, so that it appeared in the bladder cavity, and sutured the ureter to the bladder; the superfluous distal portion of the abnormal ureter was treated with the Paquelin cautery and obliterated.

The girl made a complete recovery and the dribbling of urine ceased entirely from that time forth.

FIG. 464.—SPECULUM VIEWS OF URETHRAL ORIFICE OF URETER. The figure to the left shows it contracted, that to the right, relaxed; demonstrating the end of the process of peristalsis. The greatly dilated ureter opened in the middle of the urethra and readily admitted a No. 10 Kelly speculum (i.e. 10 mm. diam.). (From Guy L. Hunner; P., J. H. H., March 4, 1900.)

Obici's case was that of a woman dying of puerperal fever, at whose autopsy a doubling of the ureters was found on both sides; on the right they both opened into the bladder at the normal situation, while the supernumerary left ureter bored its way through the bladder wall and opened into the urethra, forming the usual cyst-like dilatation in its passage through the bladder wall just before its urethral orifice was reached. No mention was made of any previous urinary symptoms.

A case of this kind relieved by a very simple procedure is shown in Figures 464 and 465. A wide opening with the cautery diverted the urine into the bladder.

One of us (Burnam) succeeded admirably in relieving two cases. In each there was a widely dilated canal running in the space between the vaginal wall and the vagina and emptying into the urethra. In the one case there was continuous dribbling of urine of good quality, containing abundant indigo-carmin on subcutaneous injection. In the other case the ureter was almost functionless, now and then discharging but causing a great deal of pain at the neck of the bladder. The first was in a young girl of 15 and the second in a woman of 30. In each case the same plan was pursued. The ureter, in each case a supernumerary organ from the right side, was opened longitudinally through the vaginal wall. Then an opening, also in a longitudinal direction,

was made between the ureter and the bladder, the mucous membranes being carefully stitched around the opening. The opening on the vaginal side and

FIG. 465.—SAGITTAL VIEW OF METHOD FOR TREATING DILATED ANOMALOUS URETER OPENING INTO URETHRA. The course of the ureter was so close to the bladder that by pressing inward with the finger in the vagina, the ureter was brought out as a distinct prominence in the bladder, emphasized by distention. Through the speculum in the urethra, Dr. Hunner introduced an electric cautery knife into the bladder and made an opening through its walls into the ureter, establishing a new intravesical orifice. The urine, which had previously dribbled from the urethra, then emptied normally into the bladder. (From Guy L. Hunner, J. H. H., March 4, 1907.)

the severed end toward the urethra were carefully closed, and, finally, the vaginal wall.

Opening of the Ureter into the Vagina.—These cases and the cases of the following group have furnished the greatest number of examples of operative interference, as the cardinal symptom, the constant dribbling of urine, is present in

all of them, and should lead us to make a most careful examination, which will in time always be rewarded by the establishment of a correct diagnosis.

(A) OF A SINGLE URETER.—Palfyn, Depaul, Davenport, Emmett, and Byfort have each reported one case of this anomaly.

Palfyn found a series of anomalies in a non-viable fetus, namely, two uteri, two vaginae, the right vagina opening into the rectum, and the left vagina receiving the single ureter which came from the two kidneys, which lay side by side and partly fused in the sacral hollow.

Depaul's case was of a somewhat similar kind; he found two completely separated uteri and vaginae, atresia ani, openings of the large and small intestines and of both ureters in the abdominal wall, the right ureter, which was markedly dilated, communicated with the right vagina by a very small opening.

Davenport correctly diagnosed a case of this nature in a woman 29 years old, who had suffered during her whole life with incontinence of urine, and had been absolutely shut off from a participation in the usual pleasures of life. Besides this incontinence, the patient voluntarily voided large quantities of urine from the bladder from time to time, and she herself had noticed that urine seemed to trickle constantly from the vagina.

By examination it was found that she had a ureter opening into the vagina. Davenport cut away the ureter from the anterior vaginal wall and inserted it into the bladder; a second operation was found necessary to close a vesical fistula. The patient had a complete recovery and was entirely cured of all her symptoms.

Byfort's case of opening of the ureter in the vagina was operated on successfully according to Davenport, who cites the case.

Emmett's case was one of the ureter opening in the upper part of the vagina in a 30-year-old woman who had always suffered with urinary incontinence. Emmett determined to perform ureteroplasty, i. e., to form a canal along the upper surface of the vagina to a point in the base of the bladder where the wall was thinnest, and he had succeeded in constructing his canal from the vaginal opening of the ureter to a point where the bladder could have been opened when the patient, unfortunately, died of an intercurrent pneumonia. The reason, of course, for this extremely difficult operation was that the ureter opened so high in the vagina that it was impossible to insert its distal end into the bladder wall.

(B) OF A SUPERNUMERARY URETER.—Alsberg found, in an 18-year-old girl, who had always suffered with incontinence and constant trickling of urine, a fistula opening in the anterior vaginal wall, connected with a small vesicle which lay beside the bladder. He regarded it as a persistent Wolffian duct, and

extirpated it as far as the parametrium. The patient died of pyemia, and at autopsy it was found that this fistulous tract was a supernumerary ureter leading to the right kidney, while the left kidney also exhibited duplicity of the ureter.

Milton reports a case of the congenital opening of a fine canal into the vagina, from which there was constantly voided an albuminous fluid free from urea. Milton, therefore, reported this as a persistent Gartner's canal. A ureteral bougie, which he, to prevent this flow of fluid, introduced into the bladder, could be introduced up to the renal origin, and the case was undoubtedly one of a supernumerary ureter from an atrophic portion of the kidney opening into the vagina.

Conitzer reports a case of bilateral duplicity of the ureters on the left side, both opening into the bladder in the normal position; on the right side only the lower one did this, the other, arising from the atrophic upper portion of the kidney, opened into the vagina in two places, with a sac-like dilatation just before the end of its course. The fluid voided through this canal contained no urea, and the canal was, therefore, regarded as a persistent Wolffian duct; after an unsuccessful attempt at extirpation of the cyst, a laparotomy was performed, at which the condition described above was found; the patient died from the effects of the operation.

Opening of the Ureter in the Vestibule of the Vagina.—As in the preceding group, these cases are of especial interest because they are often diagnosed during life, and have been operated on with success.

(A) OF A SINGLE URETER.—Such cases have been reported by Maxson, Baker (two cases), Schwarz, Schrader, Bousquet, Massari, Soller, Bois, Madden, and Colzi.

Those of Schrader and Bousquet were cases of absence of the bladder, and will be treated in the appropriate class. Baker's first case was that of a 22-year-old woman, who had always suffered from incontinence, who exhibited a ureter opening in the vestibule of the vagina, below and to the left of the urethral opening; a chemical examination showed the fluid which was passed through it to be urine, but no connection could be shown between this canal and the bladder. An operation was performed, at which this canal was slit up $1\frac{1}{2}$ centimeters and the ureter then inserted into the bladder in an opening artificially made 3 centimeters from the neck; the ureter was then covered with the vaginal mucous membrane. The patient ever after had normal retention of her urine.

Baker's second case was in a girl of 18 years, who had suffered with partial urinary incontinence since birth, and whose left ureteral orifice was found on

examination to be situated in the vestibule of the vagina close to the external ureteral meatus.

Massari's case was a child 4 years old, who had been operated on at the age of 6 months for a vaginal atresia of the anus, and had always had incontinence of urine.

The condition was not diagnosed during life, as the incontinence was thought to be due to an atonic condition of the bladder walls, but at the autopsy, the child's death being due to a second operation (a repair of the recto-vaginal fistula left from the first operation), the following condition was found: From a fused kidney whose left portion was atrophic, ran two ureters, the right one opening in the normal place, while the left one, constricted and twisted in many portions of its course, opened in the vestibule of the vagina by a very fine opening in the fold of the prepuce. The vagina was bipartite.

In Soller's case, a girl 18 years old, who had always suffered from constant trickling of urine, the ureter opened to the left of the external urethral orifice, as a ureteral bougie could be introduced for a distance of 10 centimeters up this canal. The introduction of fuchsin solution into the bladder showed that it had no communication with the ureter nor with the abnormal opening, and, after complete emptying of the bladder by catheter, the urine continued to come drop by drop from this abnormal opening.

In Bois' case there had been constant dribbling of urine, although the urine was also voided normally, and an examination showed that there was an opening beside the external urethral orifice, through which urine came drop by drop, and into which a sound could be passed for a great distance. Examinations made with sounds and with colored liquids showed that there was absolutely no communication between the bladder and the abnormal ureter. The woman having agreed gladly to any procedure which might promise her some relief from her miserable condition, Bois performed the following operation. A permanent communication was established between the cavity of the bladder and the abnormal ureter at a level with the base of the bladder, this being done by introducing a tenotome with a knot on its end into the abnormal ureter for a distance of 4 centimeters, a catheter with a gutter being introduced into the bladder at the same time; the uretero-vesical septum was then cut. This opening was kept open by having a knobbed sound passed through it every day for a week; finally the useless peripheral portion of the abnormal ureter was to be treated as a simple fistula and extirpated, but this part of the operation was postponed until a later time because of the discovery that the patient had become pregnant.

In Colzi's case the characteristic symptom, constant dribbling of urine with

regular voiding from time to time, had been present from birth, and an examination disclosed the fact that the abnormal opening was just beside the hymen. Through this opening a sound could be introduced for 30 centimeters, and further examination with colored fluids, etc., showed that there was no communication between this ureter and the bladder. There was a marked dilatation of the abnormal ureter one cm. above its orifice. From the bladder 700 c. c. of urine were voided daily, from the abnormal orifice 600, and the chemical and physical properties of the urine from the 2 sources were practically the same.

The operation was as follows: The patient being put in the lithotomy position, the prevesical space was exposed by making two incisions, one bow-shaped, so made that the top of the bow was over the juncture of the labia majora; the other, a vertical incision, running from the top of the curved incision upward over the mons veneris, and cutting the roots of the clitoris. The urethra and vagina being pressed downward, the lower portion of the pubic arch was chiseled away for a distance of $1\frac{1}{2}$ centimeters. The bladder was then laid free on its left side, and a T-shaped incision made at the place where the ureter usually enters; the peripheral portion of the abnormal ureter was then freed from its attachments and removed by knife and cautery, and the proper end sutured into the T-shaped opening in the bladder with fine silk; the flaps of the T-shaped vesical incision were then closed over it so that some approach to a sphincteral condition might be obtained. A catheter in the bladder and a sound in the ureter naturally aided the operation; healing took place *per primam*. The patient was relieved of all her unpleasant symptoms, and a cystoscopic examination showed a sufficiently wide ureteral opening of elliptical form, through which the urine flowed with perfect ease.

In Maxson's case, the diagnosis of a ureter opening abnormally just beside the external urethral orifice was made by careful examination, the use of sound, etc., in a girl who had always had the characteristic symptom of incontinence with voiding of larger quantities of urine at intervals; the operation consisted in dissecting the ureter up to the walls of the vagina, cutting off the unnecessary portion, and at a convenient place turning it into the bladder. The bladder opening was made by the help of a catheter introduced into that organ, and the ureter was drawn into the vesical opening by means of a suture withdrawn with the catheter, and sutured to the vesical wall with catgut ligatures. The vaginal wall was finally closed over the former site of the ureter and a permanent catheter left in the bladder. The healing was *per primam*, and the patient completely recovered. Two years after the operation she was in perfect health, voiding her urine absolutely normally.

In Schwarz's case, operated on by Wölfler, where the usual symptoms were present, and where absence of communication between bladder and abnormal ureter was demonstrated by the usual methods, the operation was of interest because of the novel instrument employed, a peculiar variety of clamp (much like Dupuytren's), one link of which was introduced into the bladder, the other into the abnormal ureter. Then, when the proper place had been reached, the two links were screwed together (see diagram), so that an opening was made between the bladder and the ureter by sloughing away a sufficient portion of the intervening tissue. The operation was not very successful, although after a few months the patient had practically very good control over her urination, not dribbling except after violent exertion or after partaking of large amounts of fluid, and only voiding the urine every three or four hours. The second part of the operation, the obliteration of the distal portion of the abnormal ureter, was not performed.

Madden's case was that of a girl of 16, who had suffered with constant dribbling of urine, with voiding of larger quantities at regular intervals. An examination showed a small opening in the vestibule of the vagina, $\frac{1}{2}$ an inch above the meatus, from which urine oozed drop by drop, and into which a catheter could be passed in the direction of the right kidney. Operative interference was discussed, but was not carried out.

(B) OF A SUPERNUMERARY URETER.—Cases of this abnormality have been reported by Baumm, Josso, and Albarran (2 cases).

Josso's case was of a three-weeks-old girl, in whom a dilated supernumerary right ureter opened near the external orifice; this abnormal ureter came from the upper portion of the kidney and was widened and twisted, while the ureter from the lower portion was slender and opened in the normal place. The left side was normal.

Baumm's case was of an 18-year-old girl who had suffered from birth with the characteristic symptoms, constant dribbling associated with the passage of larger quantities of urine at longer intervals. Examination showed that there was an opening in the vestibule of the vagina near the urethral opening, from which urine came drop by drop and through which a ureteral catheter could be introduced for 25 centimeters. Just back of the outlet this canal showed a distinctly dilated portion. While 1,100 cubic centimeters were voided daily from the bladder, only 200 were voided through this abnormal opening, and the physical characteristics of the two urines were distinctly different. It was established, by closure of the abnormal opening with a drawing suture and the demonstration of marked swelling along the ureter's course, that this ureter had no communication with the bladder.

The operation was as follows: *Sectio alta* was performed; the 2 normal ureteral openings in the bladder were seen; a large window was cut in the dilated portion of the third ureter, into the wall of which was inserted a circular row of silk ligatures; Baumm next sutured this to the walls of a small opening made in the bladder near the normal right ureteral opening, and the bladder incision was closed with a double row of silk sutures.

The operation was completely successful, and the passage of urine remained completely normal except for the passage of a urinary concretion five and one-half months afterward.

Albarran's two cases were in young girls, each aged 20 years, who had suffered with the characteristic variety of incontinence all their lives, and in whom all general treatment had proved of no avail. In one, besides the 2 normal openings of the ureter in the bladder, clearly shown by cystoscopic examination, a small cribriform opening was visible in the vestibule of the vagina, from which the urine came drop by drop, while vaginal examination demonstrated a dilatation of this supernumerary ureter just behind its outlet. Albarran twice tried to dissect out this supernumerary ureter and suture it into the vesical wall, but the operation failed both times because of the extreme thinness of the vaginal wall and the consequent formation of a persistent fistula.

In the other case a supernumerary ureter was discovered terminating in a little intervesico-vaginal pouch, which in turn opened into the vagina and vulva, while by cystoscopic examination the two normal ureteral openings in the bladder were easily seen. Albarran performed *sectio alta*, introduced sounds into both normal ureters, isolated from the vagina the supernumerary ureter, resected its blind end, and sutured the urethra into the bladder's posterior wall, just behind the trigonum. The catgut sutures not holding, a second operation was performed, in which a double row of sutures was employed. The success of this second operation was complete, and the patient had no further trouble.

Opening of the Ureter in Gartner's Duct.—Tangl has reported the only case of this nature, which showed the following anomalies: congenital atrophy and dystopia of the left kidney, opening of the left ureter into the persistent left Gartner's duct, which ended blindly at both ends, uterus bilocularis annicolis. The canal evidently corresponded to a persistent Gartner's canal, as it coursed for its whole length in the vaginal and uterine musculature and was lined with high cylindrical ciliated epithelium.

Opening of the Ureter in the Fallopian Tube or Uterus.—Veau mentions this as a possibility, and relates that it has been reported in a few cases of non-viable fetuses where many other congenital abnormalities were also present.

According to him a tubal orifice is somewhat less uncommon than a uterine.

Clinically, of course, these openings are of no interest whatever.

Opening of the Ureter in the Rectum and Cloaca.—Gerster reports this interesting anomaly in a child dying shortly after birth. The left ureter did not reach its normal vesical ending, but opened in the blindly ending rectum. Through the consequent stasis the kidney showed a hydronephrotic condition, which, of course, had developed during fetal life.

Oberteuffer and Revolet report the case of an abnormal fetus where cloaca formation with splitting of the bladder was to be made out, the two vasa deferentia opening into the split bladder, the ureters opening into the rectum; while Saviard reports the case of a newly born girl who showed externally no genitalia, but only a cloacal opening, into which the two vaginæ opened; the left vagina received the urethra, while the single ureter coming from the two kidneys lying side by side in the sacral hollow, opened into the cloaca.

BIBLIOGRAPHY.

- Baker, W. H., "Malpositions of the Ureter," *New York Med. J.*, 1878, xxviii, 575.
- Bostrom, E., *Beitr. z. path. Anat. d. Nieren*, Freiburg and Tübingen, 1884, Hft. 1.
- Davenport, *Amer. J. Obst. (Tr. Amer. Gyn. Asso.)*, 1890, xxiii, 1122.
- Förster, "Die Missbildungen des Menschen," Jena, 1865.
- Guessarian, "Incontinence d'urine chez la femme par anomalies de développement des organes génito-urinaires," Thèse de Paris, 1898.
- Maxson, W. H., "A Truant Ureter," *Med. News*, 1896, lxviii, 323.
- Schwarz, C., *Beitr. z. klin. Chir.*, 1896, xv, 159-244.
- Secheyron, L., *Arch. de tocol. et de gyn.*, 1889, xvi, 254; 335.
- Spaletta, *Ann. d. mal. d. org. génito-urin.*, 1896, xiv, 181.
- Veau, *Gaz. des hôp.*, 1897, lxx, 353.
- Weigert, C., *Arch. f. path. Anat.*, etc., Virchow, 1877, lxx, 490.

CHAPTER XXIX.

STRICTURE AND OTHER DISEASES OF THE URETER.

The discovery of ureteral stricture during an urological examination is too common to justify not giving the subject separate consideration, although in most instances it is but a symptom, being part of a process involving either kidney or bladder, or both. Stricture of the ureter is an extremely common complication of kidney tuberculosis. The first two cases of kidney tuberculosis in the Gynecological Department of the Johns Hopkins Hospital, May, 1890, were diagnosed ureteral strictures, the true condition not being recognized for some weeks; neither patient had vesical involvement, both survived nephrectomy, and both are still living. Strictures due to chronic pyogenic pyelonephritis are very common. Those following inflammatory reaction or ulceration about a ureteral stone are very frequently observed and treated. Rare strictures are those due to new growths, primary or secondary, of the ureter (see Chapter XXV). The rare involvement of bilharziosis is treated by Goebel (*Deut. Ztschr. f. Chir.*, 1906, lxxxi, 288). Syphilis may definitely cause stricture, and the affection is probably not nearly so rare as supposed. Its treatment is antiluetic, both general and local. See Proksch (*Arch. f. Dermat. u. Syph.*, 1899, xlviii, 224).

Cysts of the Ureter.—Excellent reviews of the question of ureteral cysts are to be found in the articles of C. Sinnreich (*Ztschr. f. Heilk.*, 1902, xxiii, 91) and Marckwald (*Munch. med. Wchnschr.*, 1898, xlv, 1,049). The latter observer has accurately described the pathological changes met with in the so-called epithelial cysts of the kidney pelvis and ureter, and has given the name ureteritis cystica to this rather rare condition, which is particularly likely to occur in early life. The cysts are invariably multiple, rarely larger than a pea, and apparently formed by the breaking down of the center of epithelial nodules. For this condition, which rarely gives symptoms, there is no recognized treatment. They appear in intra-uterine life; occasionally, as in cases referred to by Paul Wagner (*"Handbuch der Urologie,"* ii, 356), they may give rise to clinical symptoms. Saltykow (*Beitr. z. path. Anat. u. z. allg. Path.*, 1908, xlv, 393) believes that the ureteritis cystica comes from a definite

FIG. 466.—DETERMINATION OF DISTANCE OF STRICTURE OF URETER FROM VESICAL ORIFICE.

Ureteral catheters are introduced on both sides, each catheter being pushed up as far as it will go. The little rubber sleeves are then pushed up to the external urethral orifice, while the catheters are held firmly in their relative positions and simultaneously withdrawn, as shown in picture. The distance between the ends shows the distance of the stricture from the upper part of the renal pelvis.

inflammatory reaction in the so-called Brunn's epithelial nests, and that the colloidal content comes from the blood. Lievin (I. D. Bonn, 1909, "Ueber Ureteritis cystica; zur Kenntnis ihrer Genese") thinks that they come from definite glands of the ureter. In addition to these cysts there are the so-called paranephritic cysts, which usually connect by small openings with the ureter. A case of this kind has been described by Israel (*Chir. Klin. der Nierenkrankheiten*, 1901, 354). A third type of cyst is that of dilatation in one portion of the ureter. This dilatation is usually of the vesical end of the organ and leads to the well-known pouting into the bladder (Figs. 471 and 472).

The treatment of cysts of the ureter which give symptoms is, with the exception of the dilatations at the lower ureteral end, entirely by formal surgical procedure, and is directed toward relieving obstruction.

The common kinds of stricture are inflammatory, traumatic, and congenital and it is convenient to classify them according to these causes. They occur about in the order of frequency given.

Inflammatory Strictures.—These are very common, may be located at any point of the ureter, but are found especially at its vesical end. Many cases of chronic pyelitis are associated with ureteritis, and stricture formation results from the inflammation. It is not uncommon to find the condition bilateral. Gonorrheal infection is a common cause, many cases being on record; as early as 1894, one of us (Kelly) treated successfully a ureteral stricture and pyonephrosis of 150 c. c. by dilatation and irrigation ("Operative Gynecology," i, 534). Although a secondary development, the strictures in such cases assume primary importance, for the infection cannot be relieved so long as they exist. The symptoms are principally those from the associated involved bladder and kidney.

DIAGNOSIS.—The diagnosis rests on a most careful urological examination. Stricture is suggested, not proven, by a ureteral catheter meeting an impassable obstruction, for in many cases the obstruction is but a kink or a mucous membrane fold of the ureter. Such obstruction in the presence of infection is very suggestive of true stricture, especially if a comparative functional test shows reduction of secretory power. Most conclusive is the demonstration of a dilated pelvis and ureter. This can easily be carried out as shown in Figures 266 and 268. Absolute demonstration is made by the injection of 10 per cent. collargol solution, and the X-ray, which shows the location and length of the stricture. The location of the vesical end of the stricture is readily obtainable by measurement, as shown in Figure 466. The average length of an adult ureter is 28 cm. (see Fig. 130). The caliber and rigidity of the stricture can be demon-

strated by using a series of calibrated sounds or bougies, such as shown in Figure 467, and for purposes of record it is of value to use a scale and determine the force of the bite with a bougie of a given size (Fig. 468).

FIG. 467.—SERIES OF CATHETERS OR BOUGIES USED TO DILATE STRICTURE OF THE URETER.
An alligator forceps, as shown in cystoscope, can be introduced into a dilated ureter for the purpose of grasping a stone.

TREATMENT.—The treatment depends on the location of the stricture, its extent, and the condition of the kidney concerned. Primary uretero-uretero anastomosis is practically never possible, owing to infection. In every case dilatation by graduated bougies, shown in Figure 467, should be carried out with lavage of kidney (Fig. 399), and abundance of urotropin and water to

clear up the infection. It is possible to dilate a ureter by the graduated bougies to 16 mm. in a few weeks and without general anesthesia. With long strictures at the vesical end of the ureter there is a tendency to recurrence; under such circumstances uretero-vesical anastomosis offers the best results.

This operation, shown in Figure 469, can be easily carried out through a muscle-splitting extraperitoneal incision and, if desirable, under local anesthesia. Before doing this operation, the suture material being catgut, every effort should be made to secure as much freedom from infection as possible.

FIG. 468.—MEASURING THE FORCE NEEDED TO WITHDRAW A RENAL CATHETER HELD IN THE BITE OF A STRICTURED URETER. By using the same sized catheter on successive days and registering the pull, any dilatation of the stricture can be determined. ♪

When the ureter above the stricture is greatly dilated, and if the kidney function is greatly and permanently impaired, the best treatment is nephrectomy. This is especially true of strictures in the middle third of the ureter due to stone.

Traumatic Stricture.—Traumatic stricture of the vesical end of the ureter following the injuries of labor and of surgical operation, especially the Wertheim operation for cancer of the cervix uteri, is quite common. As a rule, the trauma has so interfered with the blood supply of the organ that there are lateral necrosis, a continuous leakage of urine, and uretero-vaginal fistula. The spontaneous healing of such a fistula, almost invariably, means stricture. For the treatment of such fistulae see Chapter XXXIII. As a rule, the best

and most permanent results are securable by uretero-vesical anastomosis (Fig. 469).

Traumatic stricture of the upper ureter is rare. It results as a rule from a deep contusion leading to a peri-ureteritis. The actual stricture formation

FIG. 469.—URETERO-VESICAL ANASTOMOSIS, BY THE TRANSPERITONEAL ROUTE. The end of the ureter is split, as shown, and a traction suture applied, drawing it through the hole in the bladder, as indicated. The second and third figures show the ureter fixed into the bladder by interrupted catgut sutures.

is supposed to vary in its development from a few months to years after the injury. A full account of the condition is given by K. W. Monsarrat (*Wien. med. Presse*, 1905, xlv, 1593). When very long, the only treatment is by dilatation through the bladder or directly by operative exposure through the loin. The ideal treatment, where possible, is resection and end-to-end anastomosis (Fig. 470).

Congenital Strictures.—Congenital narrowing or complete closing of the ureter is not a rare condition (Chapter XVII). Omitting from consideration the conditions of entire or partial absence, and those of extravescical opening of a ureter, there remains quite a presentable group. Dr. John Bottomley (*Ann. Surg.*, 1910, lii, 597) collected 56 cases from the literature. He observed the following points: 25 were males, 16 females, 15, sex not stated; left ureter, 27 times; right ureter, 17 times; both ureters, 10 times; upper ureter, 8 times; vesical end ureter, 38 times. Only 19 cases gave subjective symptoms.



FIG. 470.—END-TO-END ANASTOMOSIS OF CUT URETER. The longitudinal slit in the lower section permits easier invagination of the upper portion. The traction suture is placed as shown in the drawing to the left, and the two ends are united by interrupted catgut sutures, as shown in the right-hand picture.

Of considerable interest in connection with kinks and valves is a recent publication of J. Englisch (*Wiener med. Wchnschr.*, 1911, lxi, 2339), who finds in the ureters of five months' fetuses marked kinking and foldings of the mucous and muscular coats, while the fibrous coat is quite smooth. At the vesical end, well marked cysts were frequently observed.

Kinks of the ureter may be due to movable kidney and ureter, or to any condition, such as an inflammatory bowel, which fixes the organ.

The occurrence of valves in the ureter is pictured by Rayer in his "*Traité des maladies des reins*," Paris, 1837; Simon ("*Chirurgie der Nieren*," 1876, 2 Theil) suggested removal of the valves. Dr. Christian Fenger (*Chicago Med. Rec.*, 1893, iv, 155) reports a ureterotomy for such a stricture.

In the upper ureter the possibilities are resection and anastomosis, plastic widening of the canal, and dilatation. One of us (Kelly) operated with great success by this method in a case reported in the *Johns Hopkins Hospital Bulletin*, 1906, xvii, 173.

We quote verbatim:

"Mr. R. A. W., age 42, was under my care for one month, from June 10, 1900. He had had repeated attacks of severe pain in the left side, seriously interfering with his occupation, which was that of an Evangelist. These attacks began January 8, 1879, when he had a long spell of sickness, associated with a bowel trouble thought to be intussusception. The attacks were clearly renal in their origin, and nothing was found by a physical examination or an examination of the urine. I exposed the left kidney and by

rotation brought into view a large hydronephrotic pelvis of about the same size as the kidney itself. It was fusiform in shape and extended down below the lower pole of the kidney a short distance beyond the pelvis. The ureter, which began normally, suddenly contracted until it was only about 2 mm. in diameter at a point 2 cm. below the pelvis. There were no signs of any adhesions, or evidence of previous inflammation. The pelvis of the kidney, however, was thick-walled, owing to physiological hypertrophy.

Treatment: Realizing that it was impossible to do any plastic operation on so delicate a structure, I tried that which seemed to be the only feasible plan. I incised the pelvis of the kidney about a centimeter above the ureter, and then through this orifice I introduced metal catheters which I have had made for dilating strictures of the lower end of the ureter; with these I gradually dilated the stricture until a catheter about 5 mm. in diameter was passed with some apparent rupture of the inner coats of the ureter (Fig. 269). The wound in the pelvis was then closed, with fine silk and the kidney returned to its position, with a small drain. He made a perfect recovery from the operation, and has never had any pain from that day to this."

FIG. 471.—PROLAPSE OF RIGHT URETER INTO BLADDER, FORMING A CYST. Note the small orifice. (Mrs. P. From G. L. HUNNER, *Union Protes. Inf.*, Oct., 1906.)

Prolapse of the Vesical End of the Ureter into Bladder.—This very interesting condition is well shown in Figures 471 and 472. Blumer's cases are especially extraordinary. At the time of his publication (*Johns Hopkins Hospital Bulletin*, 1896, vii, 174) he was able to collect 13 cases from the literature. A most interesting case is that shown in Figure 471. One of us (Kelly) reported a case successfully treated (*Johns Hopkins Hospital Bulletin*, 1906, xvii, 173).

"A number of cases of this extraordinary condition have been reported, but so far as I know no other case has been diagnosed and treated *intra vitam*. The patient of whom I now speak, Mrs. J. W. F., came to me through the courtesy of Dr. P. M. Hicks, of San Antonio, Texas. She had had one child nine years before, with a difficult instrumental labor associated with a bad laceration. About six months before she was seen she had suffered with a bad attack of lower abdominal pain, accompanied by a temperature of 102° F., and

much tenderness in the right side. Since that time she continued to complain of backache and much pain in the lower abdomen. Vaginal examination, Dr.

Hicks wrote, revealed a retroflexed uterus and a somewhat fixed tender mass about the size of an egg in the right cul-de-sac.

"November 18, 1904, I made an abdominal incision and found both ovaries small and sclerotic, $2\frac{1}{2}$ cm. by 1 cm., and 2 by 1 cm., and the ureters appeared normal. The appendix was removed and the uterus suspended. She made a good recovery from this operation, but continued to have more or less discomfort in the lower abdomen. Upon a careful bimanual examination, November 23, 1904, it was impossible to feel anything upon the left side, while the ureter could be felt on the right through the somewhat senile vaginal wall. Upon making a vesical examination in the knee-breast posture the bladder distended well, the posterior wall dropped 6.5 cm. from the anterior wall. Through a No. 10 speculum a curious

FIG. 472.—PROLAPSE OF VESICAL END OF URETER INTO BLADDER, DUE TO STRICTURE INDUCED BY CYSTITIS. The prolapse on the right side is moderate, that on the left enormous. Note the positions of the ureteral orifices on the prolapsed sacs; also the thickened and diseased bladder mucosa, and the pseudo-diphtheritic patches on the mucous membrane. The large prolapsed sac hanging out of the neck of bladder was curled up in the cavity. $\frac{1}{2}$ natural size. (From George Blumer, *Johns Hop. Hosp. Bull.*, Sept.-Oct., 1896.)

teat of tissue could now be seen hanging down into the bladder from its base on the right side, occupying the position of the ureteral mons. This at first appeared as a short truncate cone about 1.5 cm. in diameter at its base, and 6 mm. from base to apex. From the apex clear urine fell steadily drop by drop. While in the act of watching it a remarkable transformation took place; the cone began

to swell, and in the act of swelling was forced down into the lumen of the bladder; as it continued to grow larger, its walls appeared paler, thinner, and clearer, until, at the maximum, a few red vessels could be seen coursing over the surface, which looked like a large cyst as big as the end of the thumb, full of water. With this distention the flow of urine increased in amount. Numerous translucent areas were visible scattered over the now hemispherical enlargement, which was from two to three times the size of the eminence originally observed and more rounded in form. Following this distention the cyst collapsed to its former size. As I continued to observe it, I noted a periodicity of from 5 to 10 seconds between the intervals of advancement and retraction, of expansion and contraction.

"The ureteral orifice could fortunately be seen on the anterior, inner, or urethral side of this mons, faintly outlined, forming a narrow slit not open at any time. The left or opposite ureteral orifice lay in a red mucous vesical fold not prominent in its normal position. When the mucous tissues about the right ureteral orifice became distended, the narrow opening, instead of advancing toward the median line of the bladder, remained relatively nearer to the base until the orifice came to lie wholly on one side. We had here manifestly to do with a stricture of the vesical orifice of the ureter affecting only its mucous surface.

"Treatment: The treatment was very simple. I took a delicate pair of vesical scissors, working on long parallel handles like an alligator forceps, and introduced one of the points into the ureteral slit-like orifice when the sac was fully distended and cut a slit 5 mm. in length. Fifteen c. c. of urine at once gushed out, and later 60 c. c. escaped, about half of which was estimated to come from the bladder, when the patient assumed a kneeling posture. When examined five days later, the right ureteral orifice appeared stellate, widely opened, seated on a red papillary eminence. On introducing a searcher the margins could be readily lifted apart. The opening now looked like a black hole in the bladder wall, instead of a slit situated on the side of a cyst. The patient was discharged well, February 9, 1905."

C. Adrian has reported a case of intermittent cystic dilatation of the vesical end of the left ureter (*Arch. f. klin. Chir.*, 1906, lxxviii, 588). The patient had had dull pains in the upper abdomen and in the region of the right kidney, becoming more distressing upon standing or walking; these finally became so intense that she could not sleep. A diagnosis was made when the cystoscope was used; this revealed an intermittent cystic dilatation of the vesical end of the left ureter. The condition was relieved by making a suprapubic opening

of the bladder, with an incision into the little mucous tumor, with a suturing of the vesical and ureteral mucosæ with fine catgut.

Adrian calls attention to 52 cases of dilatation reported in the literature, in 12 of which the diagnosis was made *intra vitam*. (See further literature in article by Th. Cohn, *Beiträge z. klin. Chir.*, 1904, xli, 45.) The cystic prolapse may be very small, or it may reach immense size.

In the large cases it would probably be preferable to do a suprapubic cystotomy and resect the cyst, although the simpler procedure is always to be tried first.

CHAPTER XXX.

ANATOMY AND TOPOGRAPHY OF THE FEMALE BLADDER AND URETHRA.

THE BLADDER.

The bladder is a capacious muscular pouch, situated in the anterior hemisphere of the pelvis, designed to receive and accumulate the urine from the kidneys, which it discharges from time to time by way of the urethra. Owing to the yielding character of the wall, its capacity in a state of physiological distention varies considerably, as shown in the following:

	Minimum	Maximum	Average
Adult Male	240 c. c.	1,140 c. c.	710 c. c.
Adult Female	200 c. c.	1,020 c. c.	650 c. c.

These figures are exceeded in exceptional cases, and a capacity of 3,000 to 4,000 c. c. and even more is noted without rupture.

An empty bladder in the state of muscular contraction is spherical, pear- or egg-shaped, with its upper narrow extremity leaning against the symphysis, the lower round end resting on the pelvic floor and vagina. Its length is 5 to 6 cm.; breadth, 4 to 5 cm.; depth, 2 to 2.5 cm. In the relaxed condition, especially in the more thin-walled female bladder, the vertex, with the fundus uteri resting on it, drops down onto the base, giving the bladder a peculiar gibbous appearance. It is Y-shaped if seen in sagittal section, the stem of the Y being the urethra. The longer anterior arm of the Y rests against the symphysis, while the shorter posterior arm lies on the upper vagina and cervix. Posteriorly the bladder is somewhat flattened against the cervix.

In distention the vertex is gradually lifted up from the base, which first expands backward and downward, while the lateral bladder walls expand toward the pelvic walls on both sides. Owing to the limited space in the pelvis the transverse diameter reaches its maximum sooner than the other measurements. The upper half and a part of the posterior portion are covered by peritoneum, and, as distention proceeds, the vertex rises over the symphysis, carry-

ing the line of the peritoneal reflection upward; this exposes the extraperitoneal suprapubic portion of the bladder, so important to the surgeon. The bladder is now ovoid, with the long axis pointing to the umbilicus. In excessive distention the vertex rises up to the level of the umbilicus, and the line of peritoneal reflection is 8 to 9 cm. above the symphysis.

The bladder develops from the allantois and cloaca of the embryo (Chapter III). The downward growth of the urogenital sinus divides the cloaca into anterior and posterior portions. The anterior becomes the base of the bladder and urethra, the posterior, the rectal ampulla. The upper end of the spindle-shaped allantois lies in the umbilical cord. While the bladder in the newborn is largely an abdominal organ, after birth it rapidly descends into the pelvis. It changes in shape from a spindle to an ovoid, becoming still rounder and lower in the adult. The obliterated allantoic duct is now seen as the fibromuscular urachus running between the two obliterated hypogastric arteries on the inner surface of the anterior abdominal wall from symphysis to umbilicus.

FIG. 473.—DISTENDED BLADDER AND ITS TOPOGRAPHY IN RELATION TO PERITONEUM, INTESTINES, AND PELVIC BONES. The dotted line below marks the position of the symphysis.

The peritoneal covering is limited to the upper surface, but dips down slightly on the sides and behind, forming fossæ on the two sides between bladder and pelvic wall, round ligament, and uterus. The lateral paravesical fossæ are crescent-shaped and traversed by the converging obliterated hypogastric arteries. Light peritoneal folds traverse the top of the bladder in a transverse direction. There are also a few longitudinal folds in front. In a state of distention these folds and fossæ become obliterated (Figs. 473 and 474).

The extra-peritoneal lower surface rests against the rectovesical fascia and the pubic bones with loose areolar tissue intervening; the trigonum, carrying the ureteral orifices, rests against the upper vagina and perhaps the cervix. The wide-meshed areolar tissue found everywhere at the relatively fixed base of the bladder facilitates its mobility. This is most

FIG. 474.—ANTERIOR VIEW OF DISTENDED HARDENED BLADDER. Windows are cut out of the anterior and the left lateral walls. The distribution of the muscle fibers is shown, as well as the peritoneal reflection. Through the middle window the base of the bladder and trigonum are exposed, and through the side window, the left cornu.

marked in the prevesical area, the so-called space of Retzius. With the body in the upright posture the internal urethral orifice is at the lowest point of the bladder, about 2.5 cm. back of the pubic bone.

The recto-vesical fascia (Figs. 474 and 476) resting on the levator ani is especially strong in front, forming the anterior true ligaments of the bladder, two strong bands passing on either side of the urethra from the lowest portion of the symphysis to the neck of the bladder. Similar ligaments can be differentiated in the lateral part of the fascia. These run from the white line of the obturator fascia to the lateral region of the bladder, the so-called cornu. There are also two posterior ligaments, which pass from the

neck of the bladder around the vagina and through the broad ligaments back to the fascia covering of the *M. pyriformis*.

The interior of the distended bladder is smooth except for a few mucous folds at the trigonum and internal urethral orifice. The muscle bundles of the bladder become stretched and separated from one another, leaving little interspaces through which the inner coats slightly protrude. These little pits on the mucous surface may increase in size and become herniæ or diverticula of various dimensions.

In the contracted bladder the loosely attached mucosa is thrown into

numerous folds and wrinkles, running mostly in a longitudinal direction. The internal urethral orifice is in the lowest portion of the bladder; it is crescent-shaped, concave toward the front, and shows delicate mucous folds radiating from the urethra upward and back into the trigonum, which begins at the orifice. The upper limit of the trigonum is marked by a line connecting the two ureteral orifices. The trigonal region, being less mobile than the rest of the blad-

FIG. 475.—SECTION OF THE BLADDER SHOWING GENERAL DISPOSITION OF COATS. Only a very few fibers of the inner longitudinal layer are cut in this section. X 12. (After Piersol, "Human Anatomy," 1907.)

der, remains comparatively smooth. The submucosa here being almost lacking, the mucosa rests directly on the muscle. The size of the trigonum is less affected in contraction and expansion than any other part of the bladder. The two ureteral orifices are little slits, oblique, oval, or crescent-shaped, open below and situated about 3 cm. apart on a transverse muscular ridge, the *plica ureterica*. Lateral to the ureteral orifices this ridge curves slightly upward, following the course of the intramural portion of the ureters. Back of this ridge is the retrotrigonal fossa, a shallow recess which becomes more marked on moderate distention of the bladder. On each side of the bladder is found a shallow pocket, the so-called cornu, also best seen in moderated distention. The location of these cornua corresponds to the lateral ligaments above described.

Structure of the Bladder.—There is a serous, muscular, submucous, and mucous coat richly supplied by blood-vessels, lymphatics, and nerves.

The *serosa* consists of peritoneum and a loosely constructed, subperitoneal layer of connective tissue, the fibers of which permit great mobility of the peritoneal membrane. The *muscle coat* (Fig. 477), consisting of unstriped muscle fibers, can be divided into thin outer and inner longitudinal layers with a strong circular layer between. The direction of the bundles, however, is quite irregular, the bundles of the same layer often intersecting one another, but, on the whole, the arrangement is as indicated. The bladder muscles consist of relatively coarse bundles, which become heavier still at the base of the bladder. In the trigonum the muscular layers show the greatest thickness and strength, the individual fibers, however, being more delicate and closer together than in the rest of the bladder. From this musculature arises a thick ring muscle around the internal urethral orifice, the involuntary “sphincter vesicæ.” The *submucosa* is more loosely attached to the muscle coat

FIG. 476.—RELATIONS OF URETHRA AND TRIGONUM OF BLADDER AS SEEN FROM VAGINAL SIDE. A longitudinal incision has been made through vaginal wall, from the external urethral orifice to the cervix, which is drawn aside, exposing the urethral ridge and the trigonum. The crosses indicate the internal urethral and the two ureteral orifices.

FIG. 477.—MUSCULATURE OF THE BLADDER AND URETHRA.

a. Diagram showing direction and disposition of muscle bundles composing the voluntary sphincter of the urethra (sphincter urogenitalis); the uppermost bundles (1) surround the urethra, the terminal fibers passing in an upward direction in the vesico-vaginal septum. Other fibers form a complete ring muscle (see also little figure (1) below). The middle bundles (2) surround the urethra in front, passing over onto the vagina and becoming inserted in its lateral musculature. The lowermost bundles (3) surround both the urethra and the vagina, terminating in the recto-vaginal septum. (See little figure 3 below.) The urogenital sphincter terminates at the junction of the external and middle portion of the urethra, the lowermost portion being embraced by the *M. bulbo cavernosus* with the erectile tissue of the *bulbi vestibuli* intervening.

b. Dissection of the muscle coats of the bladder and urethra. A little square has been cut in the outer longitudinal layer of the bladder muscle, exposing the fibers of the middle circular coat. The voluntary sphincter of the urethra is shown in its entirety. A portion of the pelvic fascia and the triangular ligament is removed in order to expose the urethra.

c. Diagrammatic representation of the involuntary sphincter of the urethra, the *M. sphincter trigonalis*. As shown in the figure, the fibers of this sphincter have their origin in the muscle bundles of the trigonum, the fibers passing obliquely downward and forward and surrounding the internal urethral orifice in an oblique direction. The lower circular fibers of the urethral sphincter are inserted in the lateral vaginal wall. The fibers of the inner longitudinal muscle coat of the lower urethra are relatively strong and taper as they end, only a few reaching as far as the bladder.

d. Injection of the erectile tissue of the urethral submucosa.

than to the mucous membrane. Its elastic tissue fibers permit the great changes in the arrangement of the mucous membrane incident to expansion and contraction. At the region of the trigonum the submucosa is thin or wanting. The *mucosa* is a soft, smooth, orange-pink membrane covered by a transitional epithelium similar to that of the ureter, renal pelvis, and upper urethra. The

FIG. 478.—THE ARTERIAL CIRCULATION OF THE BLADDER AND URETHRA AS SEEN FROM THE SIDE. The origin and course of the superior, middle, and inferior vesical arteries are shown, also twigs coming from the uterine artery. The urethral arteries are derived partly from the inferior vesical and partly from the vaginal; below they proceed from terminal branches of the internal pudic artery.

superficial layer consists of flattened polyhedral cells, while deeper down they are club-shaped or cylindrical. In distention of the bladder the cells flatten out, but do not lose their connection with one another.

The arteries are bilateral, coming from the right and left iliac (Figs. 478 and 479). On each side there is an inferior vesical artery coming from the anterior or posterior division of the internal iliac and running to the base and neck of the bladder and upper urethra. The middle and superior vesical arteries arise from the hypogastric artery before it becomes obli-

terated and run to the sides and top of the bladder, the superior vesical supplying the anterior vesical region. There are also twigs from the uterine and vaginal arteries. The lower half of the bladder is richer in blood supply than the top. In the contracted bladder the arteries assume a very tortuous course, which becomes straight in the state of maximum physiological distention.

The veins form a complex network around the sides, base, and neck of the bladder, draining into the lateral pelvic veins, mostly the internal iliac.

FIG. 479.—THE ARTERIAL CIRCULATION OF THE BLADDER AS SEEN FROM IN FRONT AND ABOVE. The vesico-uterine peritoneum has been removed, exposing the vascular trunks. Note the course and distribution of the middle vesical arteries. A transverse nick has been made through the urachus, in order to show the origin of the anterior peritoneal vessels coming from the inferior vesical circulation.

The lymphatics appear as a delicate network in the submucosa, the collecting channels of which receive a few tributaries from the muscle coat, or else the lymphatics of the latter follow an independent course. The lymphatics everywhere accompany the blood vessels and drain bilaterally into the internal iliac chain of glands. The inferior lymphatics occasionally traverse small intercalated lymph nodes.

The nerve supply is also bilateral; it is derived from the hypogastric plexus of the sympathetic and the third and fourth, rarely the second, sacral

nerves. These unite to form the pelvic plexus and its ganglia, extending on either side to the base of the bladder. The vesical nerves arising from this are mainly non-medullated.

THE URETHRA.

The female urethra is from 2.5 to 3 cm. long, of considerable thickness, 10-12 mm., and possesses great elasticity. The mucous surface is thrown into longitudinal folds, which give the lumen a star-shaped appearance; for this reason the canal is capable of considerable distention without injury to its coats. The urethra is gently curved around the lower border of the symphysis, the funnel-shaped vesical end being about 2.5 cm. back of the symphysis, the external orifice only 1.5 cm. away from it (Fig. 476). The latter is the narrowest portion of the tube. The *M. levator ani*, skirting the urethra on both sides, divides it into a short pelvic and a longer perineal section. In front and on the sides it borders on the pudic venous plexus, the urogenital trigonum (triangular ligament), which it perforates, the corpora cavernosa of the clitoris, and the bulbi vestibuli. Behind, the urethra is attached to the anterior vaginal wall, being more intimately connected below than above. Situated on a round prominence the external orifice or meatus is a vertical slit with more or less distinct lateral ridges, the so-called urethral labia (Fig. 480). Sometimes the orifice has the form of an inverted Y, a crescent, star, or a cross. On either side, just within a meatus, are found the delicate paraurethral ducts of Skene's glands.

FIG. 480.—URETHRA SHOWING PRONOUNCED LABIA.

The urethral mucosa (Fig. 477) shows many longitudinal folds, the largest of which is in the midline of the posterior wall. On each side of this is a parallel fold joining the middle one near the external orifice. The mucous membrane has a stratified squamous epithelium which, near the bladder, becomes transitional like the vesical epithelium, and below resembles the vaginal epithelium. The urethral glands, more numerous below, are of the branching tubular type. The submucosa carries numerous vascular papillæ containing lymph nodes. Lying close to the mucosa is a cavernous vascular network, the "*corpus spongiosum urethræ*," embedded in the submucous areolar tissue. This venous plexus extends a short distance into the muscle coats. These are of the unstriped variety and consist of a thin outer and inner longitudinal and a thick

middle circular stratum. They are continuous with the trigonal musculature above, and are known as the involuntary sphincter of the urethra. The sphincter fibers are strongest near the bladder, getting progressively thinner and ceasing altogether in the lower third of the urethra. The inner longitudinal muscle, however, is strongest at the external orifice, only a few delicate bundles reaching the inner longitudinal bladder muscle. Outside of these three unstriped muscle coats are bundles of striped muscle fibers, the *M. sphincter urogenitalis*, the "voluntary sphincter of the urethra." The bundles describe a definite ring muscle only around the upper urethra. Further down they merely form a semi-circle around the urethra in front, terminating in the lateral vaginal wall, while at the lower end they include both urethra and vagina (Fig. 477). The fibers of this voluntary sphincter are strongest below, ceasing near the bladder, the exact reverse of those of the involuntary sphincter. The urogenital sphincter does not extend to the external urethral orifice, its place there being taken by the *M. bulbo-cavernosus*, which surrounds urethra and vagina in a wide circle. Between it and the urethral orifice are the bulbi vestibuli.

The arteries of the urethra are derived from three sources on each side; the upper urethra is supplied by branches of the inferior vesical artery, the middle portion by the vaginal, the lower by branches of the internal pudic artery.

The veins drain above and behind into the vesico-vaginal plexus, below and in front into the internal pudic plexus. They freely anastomose with the cavernous veins of the body of the clitoris and the bulbi vestibuli.

The lymphatics drain upward into the hypogastric lymph glands and downward into the inguinal lymph glands.

The nerves come from the pudic and the genito-femoral, carrying sensory fibers and motor fibers for the voluntary sphincter and the vesical plexus of the sympathetic, which supplies the involuntary muscle coats of the urethra.

CHAPTER XXXI.

DIVERTICULUM OF THE BLADDER.

A vesical diverticulum is a congenital pocket, locus or sac of variable size, communicating with the cavity proper of the bladder, attached to its periphery, and lying below or at one side of, posterior to, or above the bladder. Not infrequently the added contents of several diverticula, or even a single diverticulum, may be even larger than the cavity of the bladder itself (one was a gallon in size). When it is situated near a ureteral orifice, a customary location of the diverticulum, this may open into it, or the ureter may, with growth of the sac, be drawn down into its cavity (Young), constituting an important variety.

The opening of communication varies from a wide mouth to a narrow sinus. The cavity is flat or sub-spherical, according to its size, location, and varying degrees of distention. If much pressure is habitually exerted in voiding urine the cavity may appear more or less diffusely distributed around the bladder as it moulds itself to the contiguous tissues. An interesting diverticulum, which differs generically from all others, is due to a patent urachus, which forms a pocket between the anterior abdominal wall and its peritoneum. We may exclude here diverticula extending out into an inguinal hernia, although this extension, too, may characterize a true diverticulum.

OCCURRENCE.

Diverticula, as pathological entities requiring treatment, are generally found in men, and therefore belong mostly to the province of the male urologist. In a group of 17 cases collected by Van Dam (*Beitr. z. klin. Chir.*, 1913, lxxxiii, 320) there is but one (Pean's) allotted to the female sex, and that is in a measure doubtful, as the patient, a girl of 15, had a supernumerary urethra opening into a sac without a ureter, which communicated by a narrow opening with the bladder. Other cases in women are the following:

(1) W. Alexander reports one (*Liverpool Medico-Chir. Jour.*, 1884, iv, 253) in a woman, 40 years old, admitted to the hospital "on account of her

womb coming down." She had had six children, the youngest six years old. It was after this last birth that the womb came down, but it caused no distress until two years before her admission to the hospital, when she had painful micturition and a swelling which troubled her most when standing. A globular tumor projecting from the vulva was attached to the anterior vaginal wall by a rather narrow neck. Two calculi were found and excised from this tumor, and later the anterior vaginal wall, which was lax, was removed, laying bare the base of the bladder. The bladder cyst or diverticulum which arose at the trigonum near the urethra was then tied off at its neck with strong catgut and excised, when the rest of the wound was sutured and the patient recovered with a small fistula.

(2) A large diverticulum, filled with papillary excrescences, in a woman, 59 years of age, is reported and figured by Hofmokl (*Arch. f. klin. Chir.*, 1896, lvi, 202). The patient died with an infection of the sac and lobular pneumonia, and at the autopsy an opening was found above the left ureteral orifice leading through a passage 1 cm. long into a fluctuating tumor almost the size of a child's head. On opening the sac it was found filled with pus, and its walls, which were greatly thickened and made up of muscular tissues, were covered on the inside with soft polypoid excrescences.

(3) A case of congenital diverticula is described in Kelly's "Operative Gynecology," 1898, i, plate ii. There was an opening in the bladder, 1 cm. in diameter, leading into a basin-like cavity, 1 cm. in depth, posterior to the right ureteral orifice and near enough to be mistaken at first sight for a large ureteral opening. With the contraction of the bladder the oval opening into the diverticulum closed down to a line with radiating folds (Fig. 481). Buerger (*Urologic and Cutaneous Review*, 1913, xvii, 135) has made the same observation on the contractility of the orifice, and quotes Durrieux's thesis, Paris, 1901.

We have seen another case in a woman 47 years of age, in the posterior wall, where the narrow-mouthed pocket, about 2.5 cm. in depth, was filled with small stones.

True diverticula, as a rule, occupy the lateral walls of the bladder and are apt to lie outside a ureteral orifice. They are lined with mucosa and have well-developed muscular layers. A further distinction is between diverticula, which are completely pre-formed and show all the normal tissues of the bladder in their due proportions, and those in which the pocket has become greatly enlarged after years of pressure, and there is little or no muscular tissue in the wall, due perhaps to a prostatic or other urethral obstruction associated with back pressure in urinating.

A

B

FIG. 481.—LOCULATE BLADDER. A. The loculi are seen as deep depressions in the bladder wall surrounded by muscular bands in a state of contraction. The bladder mucosa is apparently normal. B shows the same loculi with the muscular bands relaxed.

ETIOLOGY.

Etiologically, diverticula are usually formed from small preëxisting pouches or herniæ in the bladder, which become enlarged by pressure, and later come into prominence through stagnation of urine and inflammation, or by concealing a stone or a neoplasm, or by exercising damaging pressure on a ureter. It is because of the absence of these causes that we rarely see large diverticula in women. Hodgson (*Glasgow Med. J.*, 1857, iv, 29) long ago recognized that a common cause of a diverticulum was to be found in a prostatic or a urethral obstruction. R. Harrison reports a case due to violent muscular effort made in the act of being thrown from a horse.

SYMPTOMS.

The symptoms of a diverticulum are often obscure and its discovery accidental. The symptoms may be nothing more than pain and difficulty in micturition which are prolonged, and thus often attributed to the common coincident enlargement of the prostate or to a stricture. Another and more characteristic symptom is that the patient urinates, and, after emptying the bladder, in a short time has to urinate once more (*micturition en deux temps*). The pain may be unilateral over the site of the sac, where there is also a marked tenderness; or there is complaint of a sensation of not emptying the bladder in spite of a continuance of effort with tenesmus, and, at the end, the passage of pus. More rarely the first sensation is pain in one kidney, owing to the pressure of the full diverticulum upon a ureter. This leads to hydronephrosis or pyonephrosis and fever, and may even destroy the kidney.

If the bladder is washed out it is difficult to get it clean. If the diverticulum lies low and has a small orifice, it never empties itself well, and the urine stagnates.

Occasionally the history is marked by hemorrhages, which may be relieved by the insertion of a drainage catheter (Harrison).

D. W. Graham (*Ann. Surg.*, 1903, xxxvii, 470) had a patient over 70 years old unable to void, yet feeling that the bladder was full. The catheter at first brought nothing away, but after the patient walked around a bit, it was reintroduced, and a quart of urine escaped. At the autopsy a small, thick-walled bladder, resembling a uterus, was found; in the left posterior wall there was a clean-cut, sharp opening the size of a lead pencil, leading into a cavity lying behind the bladder and filling the pelvis.

As many of the patients are elderly men with enlarged prostate and cystitis, it is evident that these conditions must often obscure the symptoms arising from the diverticulum. In one case (Young) of a man 82 years of age, the first symptom was felt when a dumb-bell calculus, lying half in a dilated urachus above and half in the bladder, broke off and fell to the base of the latter. Cystoscopically the stone could be seen lying at the base of the bladder, while, at the vertex, was the projecting bar which had connected it with its fellow, still buried in the tissues above.

DIAGNOSIS.

Various conditions to be borne in mind and distinguished are these: first, broadly, the congenital and the acquired diverticula. In the congenital forms, at least while they remain small, one finds the various constituents of the

FIG. 482.—DIVERTICULUM OF THE BLADDER. The figure to the left shows a sagittal view of the fully distended and partially emptied bladder. The drawing to the right shows a speculum view of the diverticula in a partially distended bladder. (H., Oct. 19, 1903.)

bladder wall, namely, mucosa, fibrous tissue, and musculature; these layers are also found when a stone has caused a part of the bladder wall to pout out from the main cavity. When, however, a large sac is due to a pouting out of the mucosa with the cellular tissues between the muscular trabeculae, muscle may be wanting (Cruveilhier). It is also wanting when an abscess from the outside ruptures into the bladder. In a woman this may be a tubal abscess, or a suppurating dermoid or other ovarian cyst.

Note also, in a woman, not to mistake a pouching of the base of the bladder down toward the vulva (cystocele) for a diverticulum. If the patient has a lax outlet, plus a fibroid tumor which chokes the pelvis, a part of the bladder may expand upward into the abdomen and a part downward toward the pelvic floor of the outlet, the compressed part between remaining narrow and slit-like, thus making a saddle-bag or hour-glass bladder; this does not constitute a diverticulum.

E. Fuller (*Jour. Cut. and Gen.-Urin. Dis.*, 1900, xviii, 531) has described 2 cases of a congenital anomaly which can perhaps be best described by calling it an hour-glass contraction, in which the waist of the glass lies between the ureters and the urethra, making a sort of a vestibule of this part of the trigonum.

One must further distinguish the rare cases in which there is a septum extending into the bladder from its posterior wall. This may divide the organ completely in two, including the neck of the bladder and the urethra. The peritoneum usually shows a deep depression in which the rectum lies; one ureter or, if the duplicature extends above, two ureters open into each half of the bladder. These conditions have nothing in common with diverticula.

The diagnosis may be made incidentally in the course of a routine cystoscopic examination (Fig. 482). The diverticulum often does not attract attention until the urinary stagnation within the sac produces a diverticulitis. Gonorrhea is in this way a frequent provocative factor, converting an innocuous congenital malformation into a dangerous and distressing pathological condition. The contents of the sac may be so utterly different from the bladder urine, so foul and so full of pus and débris, as to present the appearance of an abscess. Suspicion ought to be aroused when such a condition has been noted for a long time. A diverticulum ought to be suspected when it takes two acts of urination to empty the bladder, a considerable amount coming away the second time. A catheter may be used twice at a brief interval to demonstrate this point. One may also draw off two different kinds of urine with a soft catheter. If a patient has constantly considerable residual urine a diverticulum should be thought of, and, indeed, it should be suspected in every vesical condition where the act of urination is seriously disturbed, and the case proves to be in some way peculiar and puzzling. Sometimes one can inject more water into the bladder than can be drawn off immediately afterward (Guthrie, "On the Anatomy and Diseases of the Urinary and Sexual Organs," 1836). One patient was not relieved until, after urinating, he pressed inside the left ischial tuberosity, when he could pass two or three ounces more (Best).

Sometimes a vague enlargement, more or less tender and resistant, can be felt per rectum or above the symphysis.

The cystoscope is the reliable means of making a positive diagnosis, revealing the opening of a pouch or of several pouches. A ureteral catheter, so

introduced into the diverticulum, will empty it of its altered urine and remove all doubt. In the smaller diverticula the mouth of the sac may contract, dilate, and contract again under observation. It is easy to mistake the opening for a dilated ureteral orifice. If the sac is full and the bladder comparatively empty, the wall of the former may bulge and give the bladder a gibbous form. R. Harrison distinguishes carefully between a pocket or pouching out of the bladder which de-

FIG. 483.—DEMONSTRATION OF DIVERTICULUM BY INTRODUCTION OF CATHETER. Left side, ureter catheterized; normal. Right side, catheter enters a diverticulum through an orifice resembling a ureteral orifice and coils up within it. The right ureteral orifice was visible and catheterized separately. (From Alfred T. Osgood, New York City.)

velops somewhere in the basal portion, generally behind the trigonum, in order to accommodate a calculus, and a true sacculation, by which, he says, "it is generally understood that a limited portion of the mucous membrane has become herniated or prolapsed through the interspaces of the muscular network supporting it."

Sometimes a clever country doctor examines his patient, feels a click and diagnoses a stone; if the expert is unable to confirm this by a careful explora-

tion, he should always think of a diverticulum and look for it. An X-ray picture will here prove decisive. Always investigate carefully any spot in the bladder where, unexpectedly, a little pus oozes out or is lodged. In an open-air cystoscopic examination this may trickle down the wall of the bladder, pointing in no uncertain way to the orifice above, and pressure may make the pus ooze out a little more freely.

In doing a lithotrity, especially in the old, where there has been much vesical disturbance extending over a considerable period, always bear in mind the possibility of another stone lodged in a pouch or in a diverticulum.

An X-ray picture may show the diverticulum like a second sphere clinging to the wall of the bladder. A good way to take this picture is to inject a heavy bismuth emulsion into the diverticulum and then introduce a solution of less specific gravity into the bladder, say the iodid of silver emulsion 2 to 3 per cent. If the sac is overshadowed by the bladder, tilt the patient well over to the opposite side in making the picture (Lerche, Fig. 488).

A fine way to demonstrate the diverticulum is to introduce a shadow catheter, or a stiletted catheter, and push it in until it coils up into the cavity, and then to take a radiograph (Brown-Osgood) (Fig. 483).

In a case of our own, a woman had a diverticulum choked with small stones in the posterior wall of the bladder; also a cystitis, which had kept recurring in spite of treatment. In searching for the mysterious cause we caught sight of a stone sticking in the orifice of the diverticulum (Fig. 484).

TREATMENT.

The various methods of treatment are:

- (1) None at all where the condition provokes no trouble.
- (2) Palliative treatment by irrigation and sterilization of the bladder in those who are too old, ill, or feeble to stand any operation. This is good preparatory treatment for an operation in most cases.
- (3) Removal of complications by crushing a stone, or by draining or removing a pus kidney, produced by the pressure of the diverticulum.
- (4) Incision of the orifice leading into the diverticulum, most suitable in little finger-tip pockets with contracted orifices.
- (5) Excision of the mucous lining of the pocket with denudation, suture, and closure of the margins of the orifice (Pousson).
- (6) Extirpation of the diverticular sac, when necessary transplanting a

ureter. This is done either (a) extravesically, (b) transvesically, or (c) by a combination of both methods.

Treatment is urgent when the diverticulum creates symptoms due to stagnation and cystitis, or when it presses upon a ureter and affects the function

FIG. 484.—METHOD OF TREATING DIVERTICULA THROUGH OPEN-AIR CYSTOSCOPE. In this case a stone is being removed. Local applications may be made, the neck of the diverticulum enlarged, and similar manipulations carried out with great ease.

of the kidney, or when it contains one or more stones. In those who are too feeble for operation, the best treatment is to wash out the bladder and to keep it clean, if possible each time catheterizing and washing out the diverticulum. When a stone in the diverticulum causes the trouble, and the orifice is large enough, our own plan of treatment can be used in women and, we doubt not, occasionally in men (Fig. 484). We distend the bladder with air, using a long, open speculum, with the patient in the knee-breast posture; then with a suitable

alligator forceps the stone is picked out of the cavity and removed. The orifice can be enlarged by incising it at several points with a cautery. If the stone is large, Young's plan of lithotripsy may be used. In a bad case it may be necessary to treat the bladder first by draining it, and to operate upon the diverticulum later. If the diverticulum is the seat of a papilloma (Buerger and others, Figs. 485 and 486), this can be treated and destroyed by fulguration, or better, by extirpation.

Before surgical treatment it is important to know the general state of health and to estimate that imponderable factor called vitality; also to know the precise condition of the urethra, bladder, ureters, and both kidneys, as well as to determine whether the diverticulum is single or multiple, whether a stone or a new growth is present, or whether the case is one of diverticulitis and nothing more.

The size of the diverticulum will have been determined by the injection and the X-ray (Fig. 487). By means of the cystoscope the exact location of the orifice is known. In the presence of a stricture or hypertrophy of the prostate, it is sometimes wiser to remove the lower obstruction and to drain the bladder as a preliminary step. It is better at first, simply to relieve the symptoms, than to run the risk of attempting a little more than the patient will stand. When he gets stronger, then the sac can be enucleated—"two-step operation."

FIG. 486. — DIVERTICULUM CLOSED; SPHINCTERIC ACTION OF THE ORIFICE. (From Leo Buerger, "Congenital Diverticulum of the Bladder with a Contractile Sphincteric Orifice," *Urologic and Cutaneous Review*, March, 1913.)

FIG. 485. — PAPILLOMA IN DIVERTICULUM. (From Leo Buerger, "Congenital Diverticulum of the Bladder with a Contractile Sphincteric Orifice," *Urologic and Cutaneous Review*, March, 1913. Lent by Buerger, N. Y.)

Van Dam recommends an extraperitoneal extirpation when the diverticulum lies in front of the bladder or lateral to it. When posterior, it is best extirpated transvesically by inverting it into the bladder, amputating it, and sewing up the orifice. It may be necessary to open the peritoneum to bring about the inversion. When it is lateral, and the ureter is in the wall, it is best to extirpate extravesically from an anterior position,

or, if this does not work, to use a combined extra- and intravesical method, or perchance a purely transvesical procedure. Pousson's method (see below) Van

Dam reserves for diverticula too firmly fixed to the surrounding parts to permit extirpation.

In making the abdominal incision to reach and effect a radical removal of the diverticulum, one may make one of four openings: (a) vertically in the median line, or (b) and (c) laterally through one of the recti muscles, or (d) horizontally through the fascia parallel to the pubic rami; the recti muscles are then pulled apart until the bladder is well exposed and can be handled in the attack upon the diverticulum. It is of the utmost advantage to introduce a

catheter into the ureter to keep it from being cut or caught in the sutures or ligatures (Chute), and to insert a rubber balloon into the diverticulum either through the urethra (Lerche, *Ann. Surg.*, Feb., 1912, Fig. 488) or through a supra-pubic vertical incision in the bladder.

FIG. 487.—DIVERTICULA OF THE URINARY BLADDER WITH SPECIAL REFERENCE TO RÖNTGEN-RAY DIAGNOSIS. (From John M. Garratt, *Surg., Gyn. and Obst.*, 1911, xiii, 292)

When the ureteral orifice lies in the diverticulum, if it is not too far

away from the opening, it may be left attached to the margin by a tongue of tissue embracing the ureteral opening, then, after removing the rest of the diverticulum, this tongue is sutured into, and helps to close the orifice (Young). With a ureter at the bottom of a deep diverticulum, cut around its orifice and transplant it into the bladder after extirpating the rest of the diverticulum. Drainage, vesical and extravesical, ought to be used liberally.

Removal of the Sac.—When the diverticulum is marked out by the inflated rubber balloon (Lerche), it can be grasped like a firm cyst and gradually lifted and dissected out of its bed, taking great care not to hurt a ureter, and catching all vessels as they appear, and tying them at once.

When it is adherent to the peritoneum, this should be carefully detached to avoid injury. If, however, it is opened, it should be closed immediately with a fine suture; this fact ought not seriously to complicate the recovery. On reaching the neck of the sac it should be clamped between two forceps and the sac removed. The vesical wound is then carefully packed off and closed with a close, fine, continuous, catgut suture, and the wound area is further inverted into the bladder with two other layers of sutures, one of which ought to be of either fine chromic gut or fine silk.

POUSSON'S PROCEDURE.

—When the diverticulum cannot be freed and enucleated, and when it is too large, or when it contains a stone which has to be removed through a suprapubic vesical incision in a feeble old patient, a safe plan of treatment is to sterilize the cavity with strong iodine solution followed by alcohol or with a 20 per cent. nitrate of silver,

followed by alcohol—and then to treat it by Pousson's procedure (*Ann. d. mal. d. org. génito-urin.*, 1901, xix, 1132). This was applied in a vigorous man of 78, who had suffered for two years from dysuria and hypertrophy of the prostate, with slight hematuria and turbid urine. After some preliminary irri-

FIG. 488.—RADIOGRAPH OF DIVERTICULUM AND BLADDER TAKEN FROM THE LEFT SIDE. Male, 38 years old. Symptoms, pain in left abdomen and incomplete urination with second action shortly after first. Diagnosis renal colic and gonorrheal cystitis. Residual urine 200 c. c. with much pus and slime; no tenderness. Cystoscopy showed a large diverticular orifice. Radiograph taken after introduction of 400 c. c. of a 5 per cent. solution of collargol into the bladder and with patient turned about 35° to show the diverticulum. The diverticulum appears in rounded outline pressing against the pelvis on the left side of the picture. The dark shadow in upper part is collargol in bladder. (William Lerche, *Ann. of Surg.*, 1912, lv, 285.)

gation and sterilization, a suprapubic opening was made and three calculi not larger than a small cherry removed. As Pousson was about to close the bladder a little pus was seen oozing from an orifice 2 cm. behind and above the ureter, and here a pocket was found containing a stone. After evacuating, irrigating, and sterilizing it with a solution of cyanid of mercury the mucosa was carefully curetted away, the margin of the opening denuded, and approximated with three catgut sutures. Lastly, the bladder incision was closed and a Pezzer catheter introduced by the urethra. The patient made a rapid recovery.

If the patient is too weak for any extirpative operation, the opening may be cut through with the cautery to enlarge it, giving free exit to its contents. If the septum between the diverticulum and the bladder is thin, this may be divided to a considerable extent. The sheet anchor of subsequent treatments rests in keeping the bladder clean by frequent irrigations.

LITERATURE.

Fundamental in the literature of diverticular bladders is the paper by J. H. Targett (*Brit. Med. J.*, 1893, ii, 218), with 15 illustrations of specimens from the various London museums. Targett cites several cases in which the sacculus is the seat of malignant disease, epithelioma, sarcoma, and fimbriated papilloma. He deals with the subject of false diverticulum or abscess cavity opening into the bladder and mentions a variety characterized by the extension of the sac between the muscular layers of the bladder wall.

Important papers and monographs are:

R. Harrison, *International Clinics*, 1894, iii, 243.

J. Englisch, *Wiener Klinik*, 1894, xx, Heft 4, 91-126.

Pagenstecher, *Arch. f. klin. Chir.*, 1904, lxxiv, 186.

Young, *Johns Hopkins Hosp. Reports*, 1906, xiii, 401.

E. M. von Eberts, *Ann. Surg.*, 1900, l, 883.

Fischer, *Surg., Gyn. and Obst.*, 1910, x, 156.

Lerche, *Ann. Surg.*, 1912, lv, 285.

Chute, *Trans. Amer. Ass. Genito-Urin. Surg.*, 1911, vi, 86.

J. M. Garratt, *Surg., Gyn., and Obst.*, 1911, xiii, 292.

CHAPTER XXXII.

EXSTROPHY OF THE BLADDER.

Exstrophy of the bladder (*ectopia vesicæ*) is a hernia of the walls of the bladder due to a developmental defect in the lower anterior abdominal wall,

FIG. 489.—EVERSION OF BLADDER. (Infant. Patient of G. L. Hunner.
Hebrew Hospital, Nov., 1911.)

which permits the extrusion and eversion of the vesical mucosa with its accompanying ureteral orifices (Fig. 489). Spooner calculates by combining several

long series of cases that an exstrophy occurs four times in 116,500. The distressing condition thus created arises from the failure of the tissues of the embryo, which go to form the abdominal walls, to meet in the median line, a defect

in the prevertebral laminae analogous to hare-lip, cleft palate, congenital omphalocele, and spina bifida. In a vesical exstrophy the anterior wall of the urethra is also wanting, while the short rudimentary penis lies wide open with its exposed reddened posterior urethral mucosa, and the prepuce hanging below a large, useless tag of redundant skin. In a girl baby the clitoris and the nymphæ are bifid and well displaced laterally (Fig. 490). A woman with exstrophy is often sexually perfect, capable of normal relations and conception. There is no symphysis, and the pubic rami are always more or less widely separated, even as much as 12 cm. Above the bladder a triangular plane of smooth skin closes the abdominal

FIG. 490.—EXSTROPHY OF THE BLADDER IN GIRL WITH PROLAPSE OF THE RECTUM. Note the deep fissure at the site of the symphysis, the labia and clitoris on either side and the exstrophied bladder lying just above.

wall and represents the region of the navel, which may be herniated.

Concomitant inguinal herniæ are often found, and in the more distressing cases there is also an extensive prolapse of the rectum to complete the miserable picture of a wretched specimen of the *gens humana* who, while able like ordinary, normal individuals to eat, enjoy, and to digest food, is utterly incapable of controlling the excrements, the waste fluids, and the ashes of combustion of the body, until they can be deposited privately and without offence in a suitable receptacle, according to the universal customs of all races. Extreme cases have

FIG. 491.—EXSTROPHY OF BLADDER IN ADULT FEMALE. The diagram above points out the topography of the case. Note wide separation of the pubic bones and recti muscles, low position of the umbilicus, and bifurcation of the clitoris. The halved clitoris is attached on either side to the top of the labium minus, the vaginal introitus is seen between the labia, and the bladder is everted. The greater rigidity of the trigonum and its attachment to the vagina holds it in place to a greater extent than the rest of the bladder, hence the characteristic T-shaped folding. Note the small surface area of the bladder mucosa; this is characteristic of the condition and is due to the fact that it has never been distended. (Patient of G. L. Hunner. C. H. and Inf., March, 1905.)

also been observed where, in the absence of the rectum, the end of the small intestine or the cecum opens into the bladder. Spina bifida, too, may be associated with an exstrophy.

The prominent clinical features are a waddling gait, due to lack of fixation at the symphysis (Fig. 491), and in the region of the genitalia the dark, vel-

FIG. 492.—EXTENSIVE CANCER OF EXSTROPHIED BLADDER. The general arrangement of the parts is similar to that in Figure 491. (Gyn. Service, J. H. H., No. 4991, Jan. 9, 1898.)

vety bladder which, in infants, rolls out like a large, fleshy tumor upon crying. The mass is exquisitely tender to touch. The everted ureteral orifices often stand out like little teats alternately spouting their jets of urine and keeping the patient constantly wet and foul, rendering him, as he grows up, utterly unfit for all social relations. The surrounding skin is often eczematous and excoriated and incrustated with urinary salts, adding greatly to the poor victim's dis-

tress. There is often a marked hydro-ureter and hydronephrosis. One ought, for this reason, not to catheterize the ureters for fear of provoking an ascending infection, pyelonephrosis, and death. Many of these patients—Neudörfer says nine-tenths—die under 7 years of age. Berger found that, of 74 patients born with an exstrophy, only 23 passed the twentieth year of life, the others dying of pyelonephritis. Occasionally one is found to live to extreme old age. As they grow older they are liable to develop cancer of the chronically irritated mucous surface, where one often finds isolated thickened patches of pavement epithelium, while in other parts an actively secreting cylindrical epithelium has formed.

Dr. Guy L. Hunner had a case of a young woman, 26 years of age, who developed a papillary adeno-carcinoma about $2\frac{1}{2}$ cm. in diameter, and with a pedicle about 1 cm. across. In such cases a radical operation (removing the cancer) is, of course, imperative. A cancerous change in the exstrophied bladder is shown in Figure 492.

TREATMENT.

Aside from surgery there is no relief from the wretched condition which compels the poor victim to live continually in a puddle of his own secretions; no mechanical device has yet been discovered which effectually catches the urine and keeps the person clean. The best that can be done is to wear diapers, changed at frequent intervals through the day.

Surgeons, therefore, naturally began early to devise means to overcome the many technical difficulties of the situation, and there are few more interesting illustrations of inventive ingenuity in surgical art than can be found in the various operations, each one correctly labeled with the name of an originator, devised to remedy nature's deficiency in the face of well-nigh insuperable obstacles.

Inasmuch as exstrophy of the bladder owes much of its distressing character to the exposure of the highly sensitive vesical mucosa as well as to the foul condition of the patient bathed in his malodorous excretions, so have the surgical operations varied, according as they attempted to relieve one or both of these conditions by a plastic operation designed to effect a restoration of the bladder cavity and construct a urethra, or by the transplantation of the ureters and the diversion of the intestinal tract, coupled with an ablation of the troublesome bladder.

The earliest plastic procedures deserve consideration because they so long taxed the ingenuity and engaged the undivided attention of surgeons, and

further because every one who sees a case for the first time is tempted strongly to see what he can do by a plastic operation; nor can it be said, as some claim, that they must to-day be relegated to the surgeon's waste basket, for our adult patients are apt to demand recourse, and we think rightly, to a procedure which will not endanger life, promising to be content if they can be rid of the extrusion, catch the urine, and escape the wetness and the smell.

Among the factors which will influence the choice of an operation or compel the operator to modify his procedure are: (1) the ill health of the patient, which will naturally check any prolonged aggressive procedure; (2) the age of the patient, for greater risks to secure continence will be taken very early in life, while an adult will naturally demand a procedure involving the least risk to life; (3) if carcinoma of the bladder has developed, a more radical extirpative operation will naturally be demanded.

If the patient has double hydro-ureters, the risks of an ascending infection are enhanced; a pyelonephritis of one side may call for extirpation of the affected kidney, and the most careful treatment of the remaining one.

Calculi have been found impacted in the ureters. Dr. G. Woolsey removed 2 large calculi from the right ureter and 5 from the left, in a boy 3 years old; he removed them by lateral incisions and then did a Maydl operation. The Trendelenburg operation ought not to be done after the eighth year.

Classification of Exstrophy Operations.

I. PLASTIC OPERATIONS ON THE BLADDER.

(1) Covering in the bladder by skin flaps taken from its sides; skin turned in onto the bladder. (Roux, Pancoast, Ayres, Wood, Maury.)

Skin slid over the defect with its raw surface next to bladder. (Thiersch.)

(2) Dissecting out the bladder without opening the peritoneum, and suturing its edges together. (Czerny.)

(3) Rupture of one or both sacro-iliac synchondroses to permit of the easy approximation of the tissues in front with denudation and closure of the fissure. (Trendelenburg.)

(4) Removal of the entire bladder, with implantation of the ureters into the base of a newly made urethra. (Sonnenburg.)

II. IMPLANTATION OF THE URETERS INTO THE INTESTINAL TRACT AND ABLATION OF THE BLADDER.

(5) Simple oblique implantation of the ureters with the formation of a protecting mucous apron (Fowler), or an oblique implantation after the method of a Witzel gastrostomy. (Stiles.)

- (6) Forming a spur or a cloaca in the sigmoid, into which the ureters are implanted by amputating the bowel and closing the lower end and anastomosing the upper end at a lower point. (Müller.)
- (7) Excision of the bladder wall, all but an oval strip at the trigonum holding the ureters; this is then implanted into the sigmoid flexure. (Maydl.)
- (8) Extraperitoneal implantation of the separated ureters with a button of surrounding mucosa into the rectum. (Lendon-Peters-Bergenheim.)

I. PLASTIC OPERATIONS ON THE BLADDER.

1. Dissecting up and Turning over a Skin Flap.—These earliest attempts simply endeavored to correct nature's deficiency through closure of the defect by taking the nearest plastic material at hand and constructing an anterior vesical wall out of the neighboring skin. The older surgeries are replete with diagrams of the various forms of flaps recommended as most likely to accomplish this almost impossible task, while the abdominal walls were attacked by relaxing incisions made to relieve the lateral tension which served to pull the wound apart and extending down even to the deep fascia. Often even the hypertrophied preputial flap has served a similar purpose, after perforation to let the glans penis through the hole, when the flap was pulled up and used to help construct the lower anterior wall. Maury, an assistant of the elder Gross, took his principal flap from the perineum and turned it up over the hiatus, making a button-hole below through which he drew the penis.

Such well-intended efforts often failed, and when only a partial union took place the secretions became more foul and ammoniacal and the parts more painful than before from the constant irritation of the hairs incrustated with urinary salts. To avoid this most serious objection, Thiersch and Billroth detached long flaps at the sides, let them granulate freely, and then slid them over the opening with the flesh surfaces toward the bladder. This, too, was difficult and subject to repeated failures and, of course, did not in any degree relieve the incontinence. J. M. Batchelor presented a case at the Southern Surgical and Gynecological Association at New Orleans (*Trans. So. Surg. and Gyn. Asso.*, 1907, xx, 531), in which he had used Thiersch's method for closing in the defect in an adult woman. The result gave comfort and entire relief with the wearing of a urinal.

2. Dissecting out the Bladder without Opening the Peritoneum and Suturing Its Edges Together.—G. B. Schmidt (*Beitr. z. klin. Chir.*, 1892, viii, 291) has

devised the plan of detaching the vesical mucosa from the underlying tissues without opening the peritoneum, but leaving the bladder attached by its middle and inferior portions. The detached margins of the organs are then sewed together so as to form a diminutive cavity, the raw area thus created being covered with two bridging flaps taken from the sides. The next stage is union of the tissues so as to form a urethra and a neck of the bladder in such a man-

Vesical mucosa

ner as to secure an elastic closure for the canal.

Schmidt describes an operation upon a little girl 2 years old. The incision through the bladder wall was made on all sides, $\frac{1}{2}$ cm. from the mucous margin. This was then dissected up for $1\frac{1}{4}$ cm., and united from side to side with 8 catgut Lembert stitches, forming a closed cylinder narrowed below to fit the urethra to be made subsequently. The raw surfaces of the bladder were covered with Thiersch flaps. The urethral canal was then constructed and connected with the bladder cavity. This method provides a good drain, tucks away the irritated bladder, enables the patient to keep dry, and sometimes ensures a small degree of continence. It serves as an alternative to Sonnenberg's method.

FIG. 493.—OPERATION FOR EXSTROPHY OF THE BLADDER IN MALE SUBJECT. At previous operation urethra had been formed. In the original state there was complete epispadias. The bladder is being dissected free from the skin, fascia and muscles, and pushed back into the abdominal cavity, which is not opened. The dotted line indicates the length and position of the splitting incision. (H. G., San., Jan., 16, 1899.)

Perhaps as good a result as can be hoped for from a purely plastic operation is illustrated by a patient from v. Hacker's Clinic (G. Lotheissen, *Beit. z. klin. Chir.*, 1900, xxviii, 528). A boy 12 years old was operated upon by peeling out the bladder free and suturing its margins together without opening the peritoneum (Czerny), associating with this the complete detachment of both recti with a piece of the pubic bone (von Schlange), and attaching them afresh to the inner surfaces of the pubic rami. The opening was narrowed and the

bladder was closed. After a reconstruction of the urethra and the closure of fistulæ the patient finally secured a passive continence, and could hold his urine with a suitable pressure apparatus for hours. In urinating, he assumed the feminine squatting posture. At night he had to be wakened repeatedly to keep him dry. The urine would gush out whenever the poor victim laughed, or coughed, or sneezed, or strongly contracted the abdominal muscles. At the very best, after interminable operations, one secures a continence of the urine lasting but an hour or two, often in a particular posture, lying on the back.

A fairly successful attempt is shown in Figures 493, 494, and 495.

3. Approximation of the Margins by Rupture of the Sacro-iliac Joint.—Perhaps as much as can be secured by plastic surgery has been attained by F. Trendelenburg (*Arch. f. klin. Chir.*, 1892, xliii, 394), who, noting that the chief cause for the repeated failures lay in the extreme tension of the margins of the wound, due to the wide separation of the ends of the symphysis, boldly chiseled through the sacro-iliac joint on one or on both sides, and then put the patient in a hammock sling with the weights pulling

in opposite directions across the body, so as to force the pubic bones to come together. The margins of the opening were then freshened and united, restoring the bladder as well as the penis, which became lengthened as the side pull was taken off. Especial care was taken to restore the musculature at the neck of the bladder above and below the sphincter region. Trendelenburg divides his procedure into three steps:

(1) Separation of the sacro-iliac joint in order to approximate the bones in front at the symphysis.

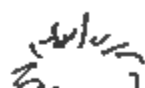
(2) Closure of the vesical cleft by broad denudation and suture.

FIG. 494.—SUTURING OF FREED BLADDER, AS SHOWN IN LAST FIGURE. Note that sutures do not pierce the mucous membrane.

(3) Closure of any persisting fistulæ.

This procedure ought not to be done in a child over eight years of age.

The operation rarely succeeds wholly at once, and has not established itself as a procedure which can be counted upon to yield results commensurate with the risks of life and the tedious operations which too often end in a reposition



of the bladder without continence. The judgment of Lotheisen in v. Hacker's Clinic (1900) is: "In allgemeinen hält man heute Trendelenburgs Verfahren für zu umständlich und zu gefährlich."

4. Extirpation of the Entire Bladder with Implantation of the Ureters into the Base of a Newly-Made Urethra.—Sonnenburg (*Dtsch. med. Wchnschr.*, 1899, 219), recognizing that the best that could be done in the vast majority of cases after repeated operations—operations which even endangered life—was to tuck in the bladder, devised the plan of extirpating the bladder mucosa and implanting the ureteral ends into a longitudinal slit in the upper urethra and then fitting

FIG. 495.—THE LAST STEP IN THE OPERATION SHOWN IN TWO PRECEDING FIGURES. The sutures in the bladder are tied, and sutures to approximate the abdominal wall are placed. Above, an opening has been left into the bladder, to prevent distention of the organ until the repaired part is healed. Note the separation at the symphysis partly replaced by fibrous bands, as shown.

the patient with a urinary reservoir. He treated 7 patients in this way without a death (Fig. 496).

The Sonnenburg operation is best adapted to an older patient where there is some impairment of the function of one or both kidneys, and where the risks of implanting the ureters into the bowel seem to be unjustifiably great.

An admirable case in point is that of Dr. J. R. Eastman (*J. Am. Med. Asso.*, 1900, xxxiv, 1103), where a boy of 13 had an exstrophy, and the urine

from the left kidney contained blood casts, also epithelial and granular casts, while the right side was not normal. The ureters were detached from the extroverted bladder and implanted into a groove made by a median sagittal incision on the dorsum of the clubbed epispadiac penis. The raw surface of the bladder

FIG. 496.—SONNENBURG'S METHOD OF TREATMENT OF EXSTROPHY. Patient 9 years old when operated upon; shown here 18 years after an operation which consisted of removing the bladder and transplanting the ureters into the upper urethra. ("Handbuch der praktischen Chirurgie," 1903, iii, 729.)

mucosa was then cut away and the margin of the defect snugly sutured over the two ureters. On account of a gangrene of the end of the left ureter, that kidney was removed, the boy recovered and was able to keep dry while wearing a urinal with a cup-shaped attachment fitting snugly over the defective area. The patient lived for six years, dying finally of an ascending nephritis of the remaining kidney.

II. VARIOUS METHODS OF IMPLANTATION OF THE URETERS INTO THE BOWEL.

A large group of operations has in recent years come into favor which rejects at once any effort to restore the parts *in situ* and attacks the problem with the idea of reflecting the malformed tissues, sacrificing the bladder and dissecting out the ureters, which are implanted in the intestinal canal at some point. Many surgeons insist that if any operation at all is done, it must be one of this group. If a carcinoma develops in the bladder mucosa then the bladder must be extirpated and the ureters implanted into some part of the bowel. The imminent danger is that of an ascending infection causing a pyelonephritis.

The advantages are the removal of the irritated bladder with its liability to cancerous degeneration; the utilization of the intestinal tract as a urinary reservoir; and the entire comfort the patients have as the bowel learns to tolerate the urine for longer intervals.

The various operations may be divided into two classes, namely, those in which the operation is transperitoneal, and those in which it is extraperitoneal.

5. Simple Oblique Implantation of the Ureters with the Formation of a Protecting Flap.—George Ryerson Fowler (*Am. J. Med. Sci.*, 1898, cxv, 270) successfully planted both ureters, cut off obliquely, into the rectum, utilizing the circular fibers of the bowel so as to form a fold and to compress and protect the ureters obturating the orifices during the passage of feces (Figs. 497 and 498).

Fowler's operation was done on a boy of 6, who lived to adult life, when he was lost sight of. Fowler says further: "The operation is performed as follows. The abdomen is opened in the median line, with the patient in the Trendelenburg position. The anal sphincters are dilated and the rectum thoroughly cleansed preliminarily. The ureters are identified in their relations to the vessels, the posterior layer of the peritoneum incised for a sufficient extent to expose them freely, and the ureters traced to their terminations upon the bladder-wall, from which they are detached. The ends of the ureters are cut off obliquely.

"A longitudinal incision, 7 cm. long, is now made in the anterior wall of the rectum, only the serous and muscular coats being included in this incision. These structures are dissected laterally until the mucous coat is bared and a diamond-shaped space in the submucous space exposed (Fig. 497 A). The edges of the incision are retracted by thread retractors, and a tongue-shaped flap of mucous membrane, with its base directed upward, is cut from the mucous membrane in the lower half of the diamond. The tongue-shaped flap is doubled

upon itself in an upward direction in such a manner that one-half of its mucous surface presents anteriorly, when it is secured by one or two catgut sutures. A flap-valve is thus secured, both sides of which are covered with mucous membrane.

"The ureters are now placed in the incision, so that their obliquely cut ends lie upon the presenting mucous membrane surface of the flap (Fig. 497, B). A few fine catgut sutures serve to secure the ureters in position in the space repre-

A

B

FIG. 497.—G. R. FOWLER'S CASE OF EPISPADIAS. Child six years old, lived to adult life and was then lost sight of. (*Amer. Jour. Med. Sci.*, March, 1898.)

sented in the upper half of the diamond, care being taken that these sutures do not invade the lumen of the ureters. The flap-valve and attached ends of the ureters are now pushed into the cavity of the rectum, and the rectal wound closed in the following manner: The gap in the mucous membrane left by the reflected half of the tongue-shaped valve is first closed by a row of catgut sutures (Fig. 498 A). The original wound in the rectal wall is closed by fine silk sutures, the upper two or three of these being likewise utilized for still further securing the ureters for the distance which they pass in the submucous space in the upper half of the diamond (Fig. 498 B). The abdominal wound is now closed.

"A remarkable fact, brought out by the after-history of this case, is the manner in which the bowel performs its double function as a receptacle for both feces and urine. While urination takes place at about the normal intervals, defecation likewise takes place at normal intervals, although the former occurs about once in six hours, while the latter occurs but once daily. The movement is generally formed, and is not mixed with or accompanied by urine, as far as gross appearances can determine." See also Stiles' method of implantation under Epispadias.

A

B

FIG. 498.—G. R. FOWLER'S CASE OF EPISPADIAS. Child lived to adult life and then lost sight of. (From *Amer. Jour. Med. Sci.*, March, 1898.)

6. Forming a Spur or Cloaca in the Sigmoid, into Which the Ureters Are Implanted by Amputating the Bowel, Closing the Lower End, and Anastomosing the Upper End at a Lower Point.—Gersuny operated by turning the ureters with their vesical orifices into a blind end of the rectum after amputating the bowel. The upper end was then implanted into itself at a point just above the sphincter region. This method is interesting on paper, but difficult and dangerous in practice.

Borelius of Lund (*Centrbl. f. Chir.*, 1903, xxx, 780) proposed an anastomosis of the sigmoid into itself, leaving a projecting loop thrown out of use,

thus short-circuiting the passage of fecal material and protecting the ureters, which were transplanted, as in a Maydl operation, into the loop of the bowel.

7. Excision of the Bladder Wall, All but an Oval Strip at the Trigonum Holding the Ureters; This Is Then Implanted into the Sigmoid Flexure.

—Maydl (*Wiener med. Wchnschr.*, 1894, xlv, and 1896, xlvi, first operation done in 1892) reported 2 cases treated by the insertion of both ureters with the connecting elliptical piece of the trigonum of the bladder into the sigmoid flexure of the colon. He operated successfully on a young man 20 years of age and a girl of 12. The basic idea in this operation is to disturb the ureters and the protective apparatus about their orifices as little as possible, so as to minimize the risks of an old ascending infection. The Maydl operation was such an improvement over the older plastic procedures and ordinary straight implantations that Stoeckel unhesitatingly says: "If we conclude to operate in a case of bladder ectopy we ought to use the Maydl procedure."

The ectopic bladder mucosa is excised and the abdomen opened; an elliptical piece of the trigonum, including the intact ureteral orifices, is spared and then sutured exactly into a long longitudinal incision in the prominent part of the easily exposed sigmoid flexure. Even after this operation, however, the patient may die of an ascending infection, either promptly or some months or years later.

It was Tuffier who first, in 1890, finding that the implantation of the cut-off ureters led to pyelonephritis, argued for the preservation of the ureteral orifices.

Whitacre (*So. Surg. and Gyn. Trans.*, 1909, xxii, 530) gives a clear description of a successful Maydl operation on a young woman 21 years of age.

After dissecting the bladder away down to the trigonum, an elliptical area of mucous membrane, including the ureteral orifices, $1\frac{1}{2}$ inches in diameter, was left intact. This was then dissected up from below and the ureters sufficiently exposed to give the necessary mobility. The abdominal cavity was then opened low down and the sigmoid flexure brought into the wound. The gut was then grasped in a gastro-enterostomy clamp and thoroughly protected by gauze sponges. The ureter, bearing a segment of the bladder, was then placed alongside the sigmoid and a preliminary continuous silk suture used to unite the outer connective tissue portion of the wall of the bladder to the peritoneum of the gut. A sufficient incision was then made in the gut and a continuous gut suture passed through all coats of the gut and of the bladder in a manner entirely analogous to that used in making a lateral anastomosis of the hollow viscera. This row of sutures was continued entirely around the fragment of the bladder and the opening into the bowel, so that the mucous surfaces of the bladder bearing the ureters became continuous with the lining mucosa of the

sigmoid. The result was that the patient left the hospital on the 23rd day with the wound healed and able to retain her urine in the rectum for 2 or 3 hours, and was well 2 years later.

Zesas (*Dtsch. Ztschr. f. Chir.*, 1909, ci, 233) collected 97 Maydl operations and found that 26 died after the operation: 13 of pyelonephritis; 5 of peritonitis; one of pneumonia; 3 of urinary infiltration; 2 of kinks in the ureters. The author prefers to put the case the other way about, and to say that, out of 97 cases operated upon for this distressing condition, 71 lived and were relieved of their disability. The continence is rarely established immediately.

8. Extraperitoneal Implantation of Intact Ureteral Orifices into the Rectum (Peters-Bergenhem).—Bergenhem was the first operator who did an extraperitoneal implantation of the ureters into the rectum (*Centrbl. f. Chir.*, 1896, xxiii, 389).

Bergenhem's patient was 35 years of age and had an exstrophy measuring 6 x 4 cm., with a separation of the symphysis of 9 cm. All the surrounding parts were in a distressing condition of eczema and furunculosis, and there was a malignant adenoma of the bladder wall. A month after excising the tumor the entire bladder was extirpated. A transverse perineal incision was then made to afford access to the ureters in front and the rectum behind; by a blunt dissection the ureters, marked out by catheters, were exposed and freed; this was not done without some small rents in the peritoneum, which were immediately closed. A little of the vesical mucosa was left around each ureteral orifice, and the ureters were brought down into the perineal wound. Two incisions were now made through the wound into the rectum and the ureteral opening conducted through these into the bowel and attached with a few sutures. The raw vesical area was then sutured together as much as possible and covered by Thiersch flaps from the sides. In the after-treatment a large drainage tube was introduced into the bowel and the perineal incision was tamponed.

When, after 5 days, the tube was taken out, the patient had attacks simulating uremia, disappearing on reintroduction of the tube. In time, however, the tube could be left out, and it was only found necessary to empty the new urinary cloaca at intervals of 3 to 4 hours by day and a couple of times at night.

The second operation of this kind was done by P. Pozza of Italy (*Gazz. d. osp.*, Milano, 1898, xix, 293).

George A. Peters of Toronto (*Brit. Med. J.*, 1901, i, 1,538), and London, of Adelaide, Australia, also originated a plan of extraperitoneal transplantation of the ureters into the lower rectum; there is a clear description of the opera-

tion by H. S. Newland in the *British Medical Journal*, 1906, i, 964 (London's paper is in the same number).

Peters' account is, in part, as follows: A boy over 5 years old had an exstrophy of the bladder; the symphysis pubis was about $1\frac{1}{2}$ inches. Along with this there was a procidentia of the rectum, the apex of the tumor during the straining reaching eight inches below the anal ring. Dr. Peters first relieved the rectal procidentia.

Three years later, July 15, 1899, the exstrophy of the bladder was treated as follows: the rectum was emptied and the sphincter stretched; a sponge attached to a tape was pushed high up into the bowel, preventing the passage of fecal matter and raising the anterior wall of the rectum toward the bladder. A small soft rubber catheter was next inserted about two inches into each ureter. A silk suture was then caught through the extreme end of the ureteral papilla and passed through the substance of the catheter to prevent its slipping out. The distal end of the ureter, with a goodly rosette of bladder muscle and mucous membrane, was then dissected free, using the catheter as a guide. As soon as the bladder wall was cut through, the lower end of the ureter was detached by a blunt dissection. After isolating both ureters in this way, the whole bladder tissue was cut away without injuring the peritoneum.

The next step was to expose the lateral aspects of the rectum below the peritoneum. The deep dissection was surprisingly easy, as by pressing back the retrovesical cellular tissue the anterior and lateral walls of the rectum were exposed. This part of the operation was also facilitated by an assistant inserting his finger into the rectum and lifting it into the wound.

The final step in the operation was the implantation of the ureters into the lateral walls of the rectum above the internal sphincter, care being taken not to kink the ureter. The opening was made high enough to permit the ureter to project slightly into the lumen of the bowel without tension. The proper point of anastomosis having been decided upon, an assistant passed a pair of slender forceps through the anus, pressed them against the spot selected, and lifted it into the anterior opening.

The wall of the bowel was then incised on the projecting forceps, making the incision just large enough to admit the catheter and the ureter, but not tight enough to press injuriously upon it. By means of the forceps, pushed through the little opening, the catheter with its attached ureter was drawn into the rectum on either side, when both ureters projected about $\frac{1}{4}$ of an inch into the bowel. The sponge plug was then withdrawn. Dr. Peters saw no necessity for stitching the ureters into position, and left the catheters in position two or three days, or until they came away of themselves. No plastic operation was

done on the abdominal wall; the wound was simply protected by a moderately firm packing of iodoform gauze, which afforded efficient drainage and, at the same time, supported and splinted the delicate ureters in their new position; the wound healed entirely by granulation, leaving a smooth, firm scar. One and a half years after the operation the boy was in perfect health, there was no prolapse of the bowel and no disturbance of the function of the kidney. Upon rectal examination, the mouth of each ureter was found to have a salient papilla the size of a little finger. The rectum was continent, and he was able to play from 1 to 3 hours without urinating, and, while in bed at night, he could go from 6 to 8 or 10 hours without an evacuation.

The advantages claimed are the following:

1. There is no danger of peritonitis.
2. A prominent natural papilla is secured, the natural manner of debouchement of a secretory duct upon a mucous surface, and the one affording the best possible protection against an ascending infection.
3. The ureters are further protected against infection or sloughing by remaining in their natural environment almost to the point of implantation.
4. The operation is easy, and free from shock and exhaustion.

Lendon's case was that of a boy of 10, upon whom he operated May 12, 1899. The method was similar to that of Peters, except that no catheter was inserted into the ureter, the end of the ureter being seized by a pair of forceps and drawn through the opening into the rectum, where it was the intention of the operator to hold it in position by a pair of clip forceps. The left ureter became permanently attached and discharged its urine into the bowel, but the right ureter, from which an assistant removed the forceps, worked back into the cellular tissue and necessitated a Maydl transperitoneal operation, setting it into the sigmoid flexure.

Newland (*Brit. Med. J.*, 1906, i, 964) had a case, a boy 7 years of age, operated upon March 29, 1904. Catheters were inserted about 2 inches up both ureters and stitched to the papillæ. He then made a circular incision as large as possible through the mucous membrane around each papilla and deepened it until the bladder wall was completely cut through. After freeing the ureters from the cellular tissue and thoroughly cleansing the bowel, an opening was made at a point about $1\frac{1}{2}$ inches above the anus by means of a forceps, and the catheter was pulled in, the ureter following. The rosette of vesical mucous membrane passed through the wound into the rectum, much as a button passes through a button-hole. With a large rosette and a small rectal wound, there is no danger of the ureter slipping out of the rectum, and there is no necessity for a restraining suture. The wound left by the transplantation of

the ureters was gently packed with iodoform gauze. The boy recovered, gradually acquiring control over the flow of urine until, at the end of a month, he remained dry all day and only occasionally wetted the bed at night.

J. J. Buchanan (*Surg., Gyn. and Obst.*, 1909, viii, 146), in a most painstaking collection of cases operated upon by the Bergenhem method, finds that in 26 extraperitoneal rectal implantations there were three deaths, a mortality of 11.5 per cent., two being due to ascending infection.

FISSURA VESICÆ SUPERIOR.

H. Braun (*Arch. f. klin. Chir.*, 1892, xliii, 185, of *Festschrift f. Prof. Thiersch*) describes a girl 15 years old who had a fissure of the upper part of the bladder toward the umbilicus, which was exstrophied, dry, and shining, 6 x 7 cm., while the lower basal part lay in its normal position with a normal urethra. The clitoris was bifid and the symphysis wanting. The defect was covered in with long Thiersch skin flaps taken from the sides in four operations. Braun cites another case—from Froriep—an autopsy in a boy three weeks old.

CHAPTER XXXIII.

VESICAL, URETERAL, AND URETHRAL FISTULÆ.

VESICAL FISTULÆ.

Vesical fistula is an abnormal opening between the bladder and a contiguous organ, associated, as a rule, with incontinence of urine, owing to its more or less continuous escape by the fistulous opening.

Entero-vesical fistula is an opening between the bladder and the bowels, either the vermiform appendix, the ileum, the sigmoid flexure, or the rectum—when the contents of the bowel may empty themselves into the bladder and out through the urethra. If the fistula is a small one, the chief inconvenience suffered by the patient is the escape of gas from the bowel into the bladder. **Fistulæ** may form between the bladder and the uterus, known as **utero-vesical fistulæ**. They may also form between the bladder and the vagina, and these, the commonest of all, are the well-known **vesico-vaginal fistulæ**.

An opening from the bladder onto the surface of the skin above the symphysis may follow an operation upon the bladder at that point or an injury such as a pistol shot, and is called **vesico-hypogastric fistula**; we will not include here cases in which there is a sinus from a pelvic abscess, a dermoid cyst, a suppurating ovarian tumor, or an extra-uterine pregnancy opening into the bladder.

ENTERO-VESICAL FISTULÆ.

Vesical fistulæ, uniting the bladder with some part of the intestinal tract, are often due to the perforation of the bowel by some sharp-pointed body, such as a pin or a spicule of bone, which then penetrates the bladder and forms an avenue of communication between the bowel and the bladder, and may itself become the nucleus of a vesical calculus. In this way, a communication has been established between the bladder and the vermiform appendix by means of a pin which has been swallowed, has wandered down the appendix to its tip, and then perforated the appendix and the bladder.

Among other common causes of these **fistulæ** are inflammatory processes,

especially of a tuberculous nature, in the bowel or in some organ lying between bowel and bladder. The destructive disease is in some cases malignant and in some syphilitic. When, as is quite frequently the case, an infected ovarian cyst, a pus tube, or an infected extra-uterine pregnancy, opens into the bladder and the bowel, there results a long and tortuous fistulous tract. On the other hand, when the disease is primary in the bowel, the opening is direct. In the male, many rectal fistulæ follow destructive disease of the prostate or seminal vesicles. Pascal (*Thèse de Paris*, 1900) has contributed an interesting study of this condition. He finds that the fistula may open anywhere into the bladder, and that the rectum is the commonest site of opening into the bowel. In 195 cases his fistulæ were: rectal, 113; colon, 42; ileum, 26; cecum, 6; cecum and appendix, 1; appendix vermiformis, 7.

Such fistulæ commonly set up an intense cystitis, and are readily distinguished by the discharge of flatus and fecal materials by the urethra. Bismuth given by the mouth will appear in the course of 24 hours in the bladder.

Treatment.—Such openings rarely heal spontaneously, and, if allowed to persist, sooner or later lead to death, through infection of the bladder and kidneys. For this reason the presence of such an opening is a positive indication for surgical interference, the one exception being, perhaps, advanced cases of malignant disease which cannot be cured.

The treatment of an entero-vesical fistula, excepting the recto-vesical, is to make an abdominal incision sufficiently wide to furnish a controlling view of the entire pelvis as well as the site of the fistula (Fig. 499), and then to carefully wall off on all sides with gauze and detach the adherent loops so as to expose and isolate the fistulous tract, which may have been marked out previously by passing a ureteral catheter through the bladder wall into the bowel.

The fistula is then carefully divided (Fig. 500); if it is necessary to sacri-

FIG. 499.—FISTULA BETWEEN SMALL INTESTINE AND BLADDER. View of adherent bowel through median abdominal incision. The position of the fistula is shown by arrow.

free one organ on account of the closeness of the attachment, it is best to make a freer dissection of the bladder, sacrificing an oval area in its walls, and cutting well out into its sound tissues. This wound is then readily closed by fine silk sutures reaching down to the mucosa; a second, and even a third layer serves

to draw the surrounding fascia over the first line and insure success (Figs. 606 and 607). The bowel opening is then dissected free on all sides down to the point of the entrance of the fistula into the lumen of the intestine, where it is excised with beveled edges, when the bowel is closed by two rows of sutures in the usual way. Sometimes the fistulous ring can be simply inverted into the lumen of the bowel and the opening closed over this, just as one inverts the stump of the appendix and closes the hole.

FIG. 500.—ADHERENT BLADDER AND BOWEL SHOWN IN LAST FIGURE SEPARATED. The openings left into both organs are closed by suture, as shown; or, if preferred, by continuous suture.

When the vermiform appendix is attached to the bladder it may be a better plan to clamp and divide it at its base and to tie off its vessels in a direction from base to tip. This makes it easier to deal with the vesical fistula, which is marked out by its

adhesion to the now movable appendix. A careful dissection can now be made down into the bladder, and a good closure secured with sutures—chromicised catgut or fine silk.

After all intestinal fistula operations, it is a wise plan to insert a small safety drain, say about the size of a cigar, wrapped in protective, into the abdomen down close to the seat of the operation. If the wound remains sweet and clean, the provisional sutures, left for this purpose, can be drawn up and closed and tied after the removal of the drain on the fourth or fifth day.

The above outlined plan is manifestly only applicable to simple fistulæ, where there is no serious disease of either bladder or bowel. In the case of malignant disease, or of tuberculosis, the general plan may have to be altered. With an inoperable cancer of the bowel the best make-shift is an entero-entero-anastomosis connecting a portion of bowel above the fistula to one below it and

preventing discharge of bowel contents into the bladder. In operable cases the diseased part of the bowel is removed and suitable measures to restore its continuity carried out. In those cases where the fistulous tract passes through a pus tube, the sac of an extra-uterine pregnancy, or an ovarian cyst, the viscera are detached and treated as outlined, after which the primary trouble is suitably treated.

Recto-vesical fistulæ below the level of Douglas' cul-de-sac constitute a class in themselves and demand special consideration. Excluding those cases where there is gross disease of the affected organs, or, in other words, where there is a simple fistula, several plans have been advocated. The most surgical and satisfactory is the following: transverse incision parallel to the symphysis pubis, through the skin, fat, and fascia, separation of the recti muscles in the mid-line, freeing of the bladder extraperitoneally to the site of the fistula, separation of the bladder and rectum, and closure of each separately in the manner already described. Such a procedure is almost invariably successful. This class of case is found exclusively in the male. Much less satisfactory results are obtained by operations through the rectum or through a suprapubic opening in the bladder. Both of these procedures have been extensively employed.

VESICO-VAGINAL, VESICO-UTERINE AND URETHRO-VAGINAL FISTULÆ.

Vesico-vaginal fistulæ, opening from the bladder into the vagina, vary in size from the diameter of a hair up to great, gaping holes, taking in the whole anterior wall of the vagina through which the opposite bladder wall prolapses.

Etiology.—The causes which give rise to vesico-vaginal fistulæ are:

1. Cancer of the cervix uteri, commonly.
2. Syphilis of vagina or bladder, rarely.
3. Difficult labor, commonly.
4. Surgical operations, occasionally.
5. Malignant disease of bladder, occasionally.

Cancer of the cervix breaks through into the bladder late in its course. The surgeon occasionally makes such a fistula by injudicious and too vigorous use of the curette as he removes the friable, cancerous tissues. The patient's discomforts are so much augmented by the added distress of the constantly escaping urine and the associated foul odor that she will hardly forgive the operator, as she generally holds him, and not the disease, responsible for her condition.

Difficult labor often gives rise to a vesico-vaginal fistula, as T. A.

FIG. 501.—EXPOSURE OF A DIFFICULT VESICO-VAGINAL FISTULA, FOLLOWING HYSTERECTOMY. a. Patient in Sims' posture, with a strong retractor introduced into the vagina. Note the distance of the fistula from the introitus. The absence of the cervix and the presence of scar tissue in the vault of the vagina always complicate the exposure of such an opening. In b the retractor is drawn forcefully in a dorsal direction, pulling the perineum and the posterior vaginal wall well out of the way. If this is insufficient, a Shuchardt pararectal incision should be made. Guy sutures, placed as shown, aid greatly in making the fistula accessible. (F. B., May 28, 1906.)

Emmett and many others before him have long since pointed out, from the impaction of the head of the child for several hours in any particular part of the pelvic canal, causing a pressure ischemia of the base of the bladder, as it is squeezed between the head and the symphysis or the pubic arch. The trouble then arises, not because forceps are used, but rather because they have not been used soon enough, or because of the failure to do a symphyseotomy or a Cesarean section in a labor almost impossible by the natural ways. Vesico-vaginal fistulæ thus commonly arise in contracted pelves or where the child is disproportionately large.

Surgical operations, in these days, usually hysterectomy for cancer or for fibroid tumors of the uterus, occasionally give rise to fistulæ situated high

.



FIG. 502.—SAGITTAL VIEW OF VESICO-VAGINAL FISTULA, WITH OPEN-AIR SPECULUM IN URETHRA. The small diagram to the right shows the speculum view of this fistula with the surrounding bladder mucosa. (F., March 3, 1900.)

up in the vagina, small in size and lying close to the scar at the vaginal vault, just under the peritoneum.

Symptoms.—The cardinal symptom of this fistula is the leakage of urine from the vagina over the person, irritating the skin, causing edema, inflammation, ulceration, and painful abscesses of the hair follicles, and disseminating from the person of the patient, wherever she may go, a foul, repulsive, urinous odor, making the room where she sits and the bed where she sleeps like a pest house. For this reason patients afflicted in this way commonly live a recluse life, rarely seeing any one outside of the immediate tolerant family.

Diagnosis.—The diagnosis of a vesico-vaginal fistula is usually easy; it may be evident at once, upon retracting the posterior vaginal wall (Fig. 501), when the bright red bladder mucosa can be seen pouting through the fistulous orifice. If the fistula, as is frequently the case, is not readily found, a couple of ounces of milk or water colored with an anilin dye, injected into the bladder through the urethra by means of a catheter and a rubber tube attached to a funnel, will reveal its presence by the little point of colored fluid escaping into

FIG. 503.—EXPOSURE OF SMALL VESICO-VAGINAL FISTULA. Procedure rendered quite simple by the fact that the cervix and the anterior vaginal wall can be drawn almost out of the vaginal introitus. The figure to the right shows the closure of this fistula with two layers of sutures. (F., March 3, 1900.)

the vagina. It is frequently a valuable aid to examine from the vesical side by a cystoscope, as shown in Figure 502.

In the case of a minute fistula, it is often a good plan to put an absorbent cotton pack in the vagina, after filling the bladder with the anilin solution. If there is a fistula, the cotton in the vagina will be stained at the point of its escape. If the cotton collects clear urine, while the bladder urine is strongly colored, then the fistula is ureteral, not vesical. When there is much inflammation and the parts are tender, it is best to put the patient completely under the influence of anesthesia before making a thorough examination.

Treatment.—The object in the treatment of a vesico-vaginal fistula is to close it firmly, so as to restore vesical continence.

FIG. 504.—SPONGE ON CLAMP INTRODUCED INTO BLADDER THROUGH FISTULA AS AID IN DENUDATION. The edge of the fistula can thus be everted and made taut, facilitating denudation with the scissors.

The simplest classification of vesico-genital fistulæ recognizes the following five forms:

1. Vesico-vaginal.
2. Vesico-cervico-vaginal, superficial and deep.
3. Vesico-uterine.
4. Vesico-urethro-vaginal, involving the neck of the bladder.
5. Urethro-vaginal. See Urethral Fistula.

Each of these forms calls for separate consideration and different plans of treatment.

Before proceeding to details it seems well to recall the general principles involved.

CONDITIONS OF SUCCESS COMMON TO ALL PLASTIC OPERATIONS.—Success in treating a vesico-vaginal fistula depends first, upon dealing suitably with any existing complications, and then upon securing a good denudation in well-vascularized plastic tissues, that the tissues can be splinted during the healing process in snug coaptation without undue tension. The approximation of the tissues must be maintained by a suture material which will last at least 8 or 10 days, the parts must be kept clean while the union is being established, and, as a rule, the bladder must be kept at rest by drainage. These general principles are attained in some cases quite readily, in others only by extreme care, removing one or the other of the various pre-existing complications.

POSTURE.—The best posture is the one which renders the fistula most accessible and at the same time is most convenient for the operator, his assistants, and the anesthetist. The lithotomy or the exaggerated lithotomy (Simon's) is generally the most satisfactory; Sims' posture is sometimes excellent; occasionally an operation can be done with greater ease and dispatch in the knee-breast posture than in any other.

ANESTHESIA.—Many operations can be done under local anesthesia. Novocain, 2 per cent. aqueous solution, to which a little 1 to 100,000 adrenalin is added, is ideal. In addition to infiltrating the tissues about the fistula, it is a great help to thoroughly inject the perineum. This permits of retraction without discomfort.

Where local anesthesia is not satisfactory an ideal substitute is found in the mixture of gas, oxygen, and ether in such general use.

FIG. 505.—SICKLE-SHAPED KNIFE; SHARP ON BOTH SIDES. It is very convenient in dissecting the bladder free from the vagina and also convenient in making vesico-vaginal fistulæ for purposes of treatment. ($\frac{3}{4}$ natural size.)

FIG. 506.—DELICATE SCISSORS CURVED ON THE FLAT, FOR PARING EDGES OF VESICO-VAGINAL FISTULÆ. ($\frac{3}{8}$ natural size.)

OPERATION.—With the patient in a lithotomy posture and the posterior vaginal wall well retracted, the next step is to proceed to bring the fistulous area down as near to the observer as possible. This can often be done by passing



I

FIG. 507.—IMMENSE VESICO-VAGINAL FISTULA, INVOLVING ENTIRE TRIGONUM, INCLUDING SPHINCTER AREA. The ureteral orifices are still open in bladder. Figure I shows the separation of the bladder from the vagina. A denudation is carried all the way around the fistula. Figure II shows placing of the sutures. Great care must be taken not to include the bladder mucosa and to close the angles perfectly. The sutures below include the mobilized bladder, care being taken to include a large bite. In front, they include both bladder and vagina. (H., Oct. 31, 1900.)

4 stout silk sutures through the thickness of the vaginal walls in front of, and behind, and on each side of the fistula (Fig. 501). The fistula can now be pulled down and exposed for operation as readily as though it lay on the surface of the body. Oftentimes it is sufficient to catch the cervix with a stout tenaculum forceps and haul it down to bring the fistula with it almost to the vulva (Fig. 503). On the other hand, much is also gained by retracting the perineum as far back as possible (Fig. 501 b). In many cases great gain is made by making a deep para-rectal incision through the perineum, as shown in Figure 536.

This is readily closed at the end of operation. By these devices, by pulling the fistula down, and by hauling the perineum up, two inches or more can be gained. The plan shown in Figure 504 is frequently a very effectual one in exposing the edges of fistula.

The instruments needed are a speculum, scalpel, mouse-tooth tissue forceps, delicate scissors (Figs. 505 and 506), artery forceps, fine needles, needle-holder, and suture material.

Denudation.—The best method of denudation is the one which sacri-

fices the least tissue, and this is done by cutting through the vaginal tissues at each end of the opening down to the bladder wall (Fig. 507), then freeing the bladder on all sides from the vagina by running a scalpel around between them, when the bladder can be brought together as a separate organ without any tension being placed on the binding sutures (Fig. 508).

Line of Union.—The tissues should be brought together in the direction in which they most naturally and readily fall into apposition. It is not necessary for the line of bladder union to coincide with the vaginal

FIG. 508.—FISTULA SHOWN IN LAST FIGURE, WITH SUTURES TIED. The bladder, loosened posteriorly, is now drawn forward and the sutures tied. No attempt is now to be made to cover over the raw bladder surface with the scarred and rigid vagina, as nature will soon hide all traces of the operation and there will be no visible defect.

line. Other things being equal, in all larger fistulæ a transverse or slightly oblique line of suture of the vaginal tissue is best (Figs. 509 and 510, 511 and 512; also 516, 523, 524). It is, as a rule, more difficult to draw the tissues together in the direction of the axis of the vagina than across its axis.

Suture.—Fine needles are used for the sewing, and we prefer chromic catgut for the bladder, and fine silkworm-gut or fine silver wire for the vaginal wall. With the bladder wall detached from the vagina, it is good to unite the under raw surfaces of the bladder, throwing a ridge of tissue upwards into

the viscus by 2 layers of fine chromic gut; silk or linen thread may also be used. A fine silkworm-gut or fine silver wire does well to hold the vaginal tissues in apposition, avoiding any dead spaces between the vesical and the vaginal planes.

Where the surrounding tissues are not involved and the margins of the

FIG. 509.—PARING EDGES OF VESICO-VAGINAL FISTULA PREPARATORY TO CLOSURE. The patient should be in the elevated perineal posture. The anterior vaginal wall in which the fistula lies is exposed by a large posterior retractor and two small lateral retractors, as shown. The amount of denudation is indicated by the outline.

FIG. 510.—CLOSURE OF VESICO-VAGINAL FISTULA. The pared vaginal edges are brought together with interrupted transverse sutures, going down to, but not including the mucous membrane of the bladder. The best suture material is fine silkworm gut or fine silver wire. The upper and lowermost sutures should unite the tissues well beyond the opening.

fistula can be easily drawn together, then the classical operation of Sims can be done with every assurance of success.

In this a broad strip of tissue is removed from the edges of the fistula on all sides, extending up to, but not including, the mucous membrane of the bladder (Fig. 509).

The next step is to pass a series of silver wire or silkworm-gut sutures about five millimeters apart, which, when shotted or tied, will serve to bring the

apposed raw surfaces into accurate apposition and splint them without undue tension until firm union has taken place (Fig. 510).

Simon, the great German operator of a half century ago, was fond of passing alternate sutures at a greater distance from the edges of the wound, which served, when tied, to relax the tissues for the accurate work of approximation secured by the intermediate sutures.

A f t e r - T r e a t m e n t.—After suturing the parts together, it is always best to test if the sewing is water-tight by injecting an anilin solution into the bladder, say 150 c. c., to discover any weak points. If any are found, other sutures are carefully placed there at once, or the whole is ripped out and done over. If the operation is really well done, the operator can feel sure in advance of the test that no fluid will escape. A

mushroom catheter (Fig. 513), with a stem, about 5 mm. in diameter, is inserted into the bladder through the urethra; through this the urine drains continually into a receptacle at the side of the patient containing some 5 per cent.

FIG. 512.—CLOSURE OF VESICO-VAGINAL FISTULA, AS IN LAST FIGURE, WITH A SEPARATE LAYER OF SUTURES FOR THE BLADDER. The buried sutures are of cat-gut.

carbolic acid solution. Once or twice a day the bladder is washed out with warm boric acid solution, and once a day 2 oz. of 1 to 1,000 or 1,500 nitrate of silver solution is thrown into the bladder after irrigation. A very valuable irrigation is that of 1 to 1,000 formalin solu-

tion. After 6 or 8 days the catheter may be withdrawn.

The bowels should be moved on the third day by giving a laxative the evening before. After this the food need not be restricted.

A rest of 8 to 10 days in bed will be necessary according to the severity of the case.

FIG. 511.—CLOSURE OF A VESICO-VAGINAL FISTULA WITH SUTURES PLACED IN ANTERO-POSTERIOR DIRECTION MAKING A TRANSVERSE LINE WHEN TIED. The procedure is the same as shown in the last figure except that the line of suturing, when completed, is from behind forward, instead of from side to side.

VESICO-CERVICO-VAGINAL FISTULA.—When the fistula is in juxtaposition to the neck of the womb it is a vesico-cervico-vaginal fistula. This form may

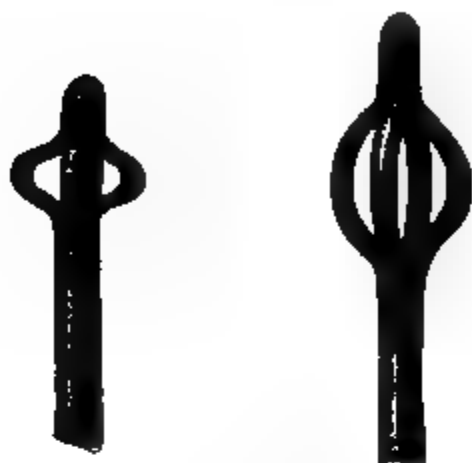


FIG. 513.—THREE STYLES OF SELF-RETAINING CATHETER. These catheters are made of soft rubber and should be about 25 cm. long. The third is the one commonly used; in order to be able to irrigate through it with greater ease, it is often best to cut the holes larger.

be superficial or, when there has been much destruction of the neck, throwing it higher up in the midst of a mass of scar tissue, it is a deep vesico-cervico-vaginal fistula. These forms attracted much attention from the earlier operators, as they are not uncommon and, where one is limited to the simple plan of denudation, approximation, and suture, they may be difficult to handle. Jobert de Lamballe and many others after him sometimes denuded the posterior cervical

lip and sewed it to the anterior margin of the fistula, in this way closing the opening and also turning the uterine orifice into the bladder, through which the patient was then destined to menstruate.

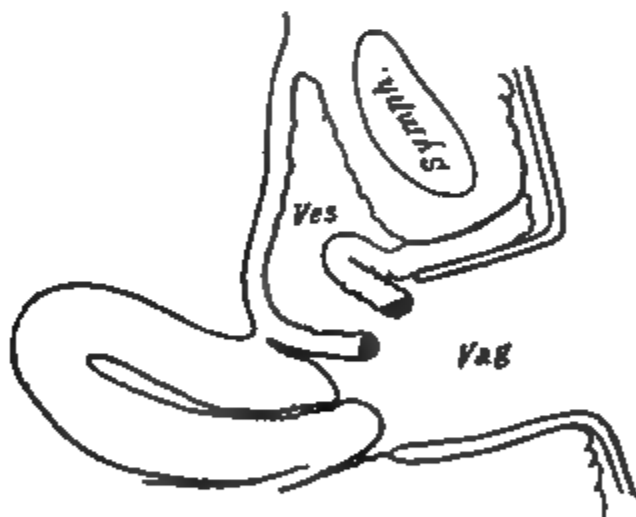


FIG. 514.—VESICO-CERVICO-VAGINAL FISTULA. Dissected free and ready for suture.

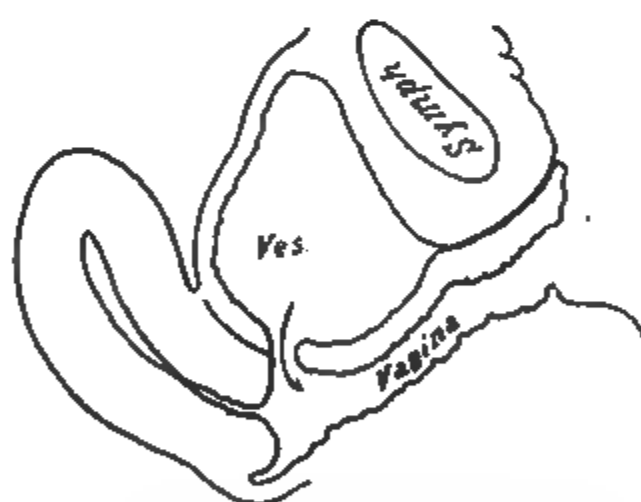


FIG. 515. — VESICO-CERVICO-VAGINAL FISTULA. The dotted line indicates the plane of the dissection made to mobilize the bladder by freeing it from the uterus.

The best plan of treatment here is to grasp the cervix and pull it down and back; then to cut transversely between the fistulous orifice and the uterus, completely severing the vaginal vault and the bladder from the cervix. After

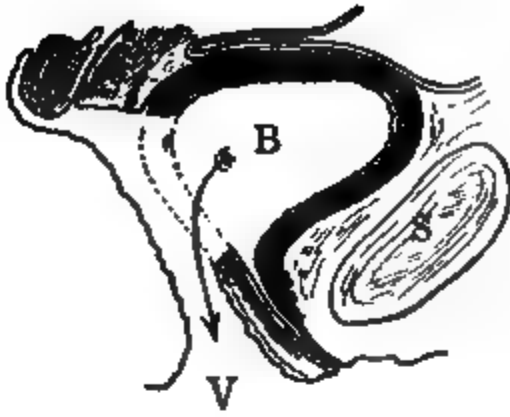


FIG. 516.—VESICO-CERVICO-VAGINAL FISTULA. Showing way in which the bladder was detached from the uterus, a to x, and brought down and sewn to denuded vagina at b.

freeing the bladder in this way it can then be sewed up with two or three layers of fine chromic catgut, turning it in on itself. The general plan of this operation is well shown in Figures 514, 515, and 516. A little drain is then laid in

FIG. 517.—CLOSURE OF VESICO-UTERINE FISTULA, FROM BELOW. The sutures closing the denuded and mobilized bladder are in place, ready to tie.

front of the cervix to carry off any secretions, and the bladder is drained for from 6 to 8 days with a catheter.

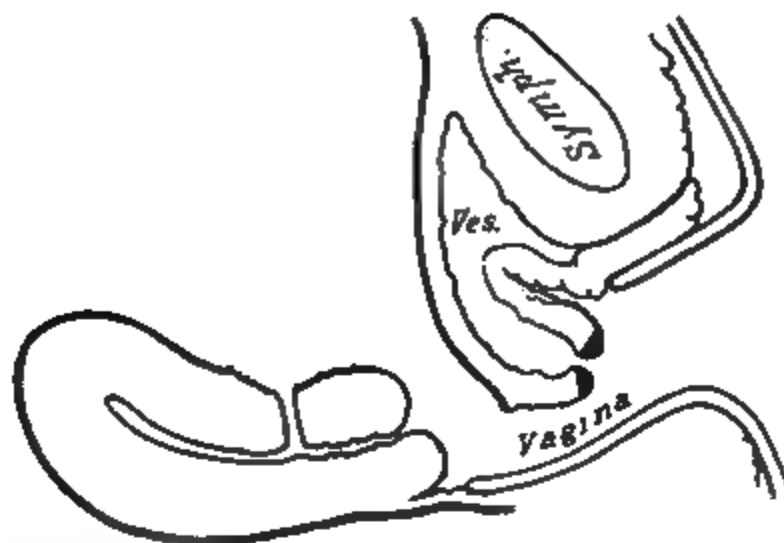


FIG. 518.—VESICO-UTERINE FISTULA. The bladder has been completely detached from the uterus and can now readily be sewn up. The utero-vesical space may be drained or closed at once; the choice of procedure will depend upon the character of the operation and the presence or absence of infection.

VESICO-UTERINE FISTULA.—A vesico-uterine fistula opens from the bladder into the cervix and is not visible. It can be detected by the flow of urine from the cervix and by passing a probe through the bladder and across the fistula into

FIG. 519.—VESICO-UTERINE FISTULA TREATED THROUGH MEDIAN ABDOMINAL INCISION. The bladder is separated from the uterus and each opening closed separately. A drain is inserted at the site of the fistula leading into the vagina.

the uterus and then touching it with another probe passed into the cervical canal. The plan of treatment here is to separate the anterior vaginal vault from the cervix and to dissect the bladder free up to, across, and beyond the opening until there is plenty of slack bladder tissue around it, when it is closed with a fine needle and fine chromic gut in two or three layers. It is not necessary to close the uterine end of the opening, although this is a simple procedure. Next close the vaginal vault down to a small opening and insert a little cigarette drain for a few days. See Figures 517 and 518, also 519-521.

VESICO-URETHRO-VAGINAL FISTULA.—A fistula at the neck of the bladder is always serious, as it may involve the entire destruction of the sphincter muscle and so condemn the patient to a urethral incontinence when the hole is closed, which is no less annoying than was the flow through the fistula, for no operation is successful from the patient's standpoint unless she secures perfect urinary control.

In operating here it is most important (a) not to sacrifice any tissue, (b) to avoid as far as possible introducing scar tissue into the wound area. Begin the denudation by splitting the vagina in the median line, starting at the fistula, and extending on down the urethra. Then, by turning over little

flaps of vaginal mucosa on either side, a raw area is secured covering the anterior part of the fistula, which is the most difficult to get at. Then the posterior margin is split in the median line up toward the cervix for about one centimeter, and the little flaps dissected up from the bladder mucosa out to each side until a wide area is exposed, and the anterior and posterior denudations are joined at the right and the left angles.

The denuded and, to some extent, liberated bladder is now rolled forward onto the urethral portion, raw surface to raw surface, and sewed snugly there with fine needles and very fine, continuous, chromic catgut suture. It sometimes is a great help to unite the median portions of the wound with a single interrupted stitch. This same principle is also a good one in dealing with large fistulæ of the base of the bladder, where the wound can be divided up advantageously by two or three fine interrupted sutures. The fine continuous

FIG. 520.—TREATMENT OF VESICO-UTERINE FISTULA BY ABDOMINAL INCISION. The vesico-uterine fold of peritoneum (P-P) is divided, and the fistula (F) exposed and detached from the uterus. (von Dittel.)

chromic gut suture is then used to effect an accurate closure from end to end, or rather from near the center out to one end and then back to the center, and then out to the opposite end and back again, when it is held at the starting point. By using a fine needle and fine suture the tissues are not injured and the sutures can be placed close together, making a more secure closure. If there is any tension two or three silkworm-gut sutures will relieve that and make the fine suture work more effective. It is good to end up with the last row just under the vaginal wall, completely buried out of sight. In many large fistulæ it is possible to bring the bladder together, but not the vaginal wall. Such a condition is shown in Figures 507 and 508.

When the suturing is done at or close up to the neck of the bladder, or involves the urethra, it is best to avoid using a permanent catheter lying in direct contact with the line of approximation. In these cases it is good to make a stab wound in the median line through the bladder walls well above the suturing area, draining in this way until the tissues are well united, when the catheter is pulled out and the vesical opening rapidly closes of itself.

URETHRO-VAGINAL FISTULA.—See Urethral Fistula.

No satisfactory apparatus has been devised for collecting the urine leaking

from a vesico-vaginal fistula when the patient is up; lying in bed very good results are obtainable by inserting a large mushroom catheter (Fig. 513) into the vagina and by tubing to connect it with a convenient receptacle.

As, for reasons of treatment, it is often desirable to leave fistulæ open—and in some cases it is impossible to close them—it would be a great contribution to the treatment if a really practical mechanical apparatus were in use.

We have merely outlined the question of operative treatment. Not every fistula can be closed by the vaginal route, and it seems wise to add something as to the complications. Each case must be judged on its own merits, and, among difficult cases, no two operations will be identical.

FIG. 521. — VESICO-UTERINE FISTULA CLOSED BY OPERATION FROM ABOVE. The hole in the bladder is now sewed up and then the vesico-uterine plica (P) is restored. Finally the abdominal incision is closed and the bladder drained with a mushroom catheter for a few days. If the opening into the uterus is low down, it will sometimes be best to split the cervix into the vagina and drain the wound area through it.

Complications.—The complications threatening the success of the operation may lie in the character of the fistula itself, which is either minute or extensive, or it may be that it is inaccessible, or that the surrounding conditions offer difficulties such as scar tissue, a ruptured perineum, pelvic inflammatory disease, etc.

The following is a categorical list of the more important complications met with:

1. The fistula may be minute, as fine as a hair, rendering its discovery difficult. Once located the treatment is simple.
2. It may be large enough to involve the whole base of the bladder and the anterior vaginal wall.
3. It may be embedded in the unyielding vaginal scar tissues.
4. It may be so high up in the vaginal vault as to be inaccessible.
5. It may adhere to one or both pubic rami.
6. The destruction of tissue may involve the anterior lip of the cervix, which is more or less completely destroyed (fistula laqueatica).
7. It may involve the urethra at the neck of the bladder, and with it the vesical sphincter.
8. The whole urethra may also be destroyed.
9. Two or three vesico-vaginal fistulæ may exist at the same time.
10. A vesical fistula may be coincident with a vesico-uterine fistula.
11. A vesical fistula may be coincident with a urethro-vaginal fistula.
12. One or both ureters may be caught and compressed in the margins of the fistula.
13. A vesical fistula may be associated with rupture of the symphysis pubis, and sometimes with necrosis of the bone.
14. It may be associated with a complete tear of the perineum.
15. It may be associated with a recto-vaginal fistula.
16. There may be a coincident pyelonephritis, usually due to an ascending infection.
17. There may be prolapse and thickening of the inflamed bladder wall, through the large fistula.
18. There may be cicatricial narrowing of the vagina, especially at its outlet.
19. There may be more or less extensive vaginal and vulvar inflammation, with follicular abscesses and incrustations on the raw tissues.
20. Vesico-vaginal may be coincident with uretero-vaginal fistula.
21. There may be pelvic inflammatory disease fixing the uterus.
22. Fistula may follow hysterectomy.

Perhaps the simplest and most easily managed of these complications is the preliminary clearing up of infection in the vagina and around the fistula. It is indispensable to satisfactory results.

Bad cases of vulvar and vaginal excoriations and inflammation and badly inflamed bladders often demand some weeks of preparatory treatment to get the tissues into proper condition for an operation. When the vaginal outlet is open, affording free ingress and egress to fluids, the patient may be kept in a warm bath for several hours each day, extending for a period of from one to several weeks. In some cases continuous tubs are of great advantage. Patients may lie on a canvas hammock, in a tub, out of the water, and by suitable apparatus a continuous irrigation with plain water or any desired fluid may be kept up. This plan of G. L. Hunner's often so ameliorates the local conditions that an operation can then be done successfully.

The use of a stiff oxid of zinc paste over the excoriated skin and vulvar parts relieves pain and promotes healing.

In some of the worst cases we find that it is a good plan to put the patient under anesthesia, say once every 5 days, for 4 or 5 times, and then go to work and cleanse the internal parts, which we prefer to do in the knee-breast posture, vigorously scrubbing off all the incrustations from the vaginal and vesical surfaces; then applying carefully to all wounded surfaces a nitrate of silver solution, varying in strength from 5 to 10 per cent. No other plan will so speedily hasten the healing of the wounded surfaces and prepare the patient for the operation, which can be done as soon as the surrounding parts become normal.

Let us now consider some of the more important and frequent of these complications.

FIG. 522.—LARGE FISTULA WITH RIGID VAGINAL WALLS. The bladder has been dissected free and sewn together, as shown. The suturing should be close and in two layers at least. With careful post-operative attention as to cleanliness such a fistula will heal without any approximation of the vaginal wall.

VERY LARGE FISTULÆ.—In some of the worst fistulæ the opposite wall of the bladder is found prolapsed through the opening into the vagina, where it appears as an angry, red, sometimes strangulated and edematous mass, inflamed, ulcerated, or coated with gritty material. The general preparations described above apply here, and, in addition, the blad-

der should be replaced and prevented from falling into the vagina by packing it from time to time. At the time of the operation the bladder can be restored, and retained by the posture of the patient, either the left lateral or the knee-breast position. A rubber balloon with a stem to it can also be inserted in the

bladder cavity, the stem brought out of the urethra, and the bladder blown up.

When the fistula is so large that the vaginal tissues cannot be united, one must do as much as possible with the available tissues and leave the rest bare.

FIG. 523.—DUDLEY'S OPERATION FOR LARGE VESICO-VAGINAL FISTULA WITH RIGID EDGES. The diagram shows left half of the bladder. The denudation includes the anterior part of the fistula, ff; on reaching the point d, in place of extending backward to the cervix, it runs upward in a semicircular denudation in the bladder. Some of the sutures are already placed. As a result of this operation, the part of the bladder behind the sutures, as indicated by df, is left out of the newly formed bladder and becomes a part of the vagina.

FIG. 524.—DUDLEY'S OPERATION COMPLETED. (See last figure.) The part of the anterior vaginal wall back of the suture is made up of vesical mucosa. Although the bladder appears much smaller in our sketch, its size was, in reality, not greatly reduced.

This uncovered area becomes covered with epithelium, so that in a short time it is impossible to recognize that the vagina has not covered the wound throughout as usual (Fig. 522).

In the case of a large fistula some of the older workers deliberately adopted the plan of closing as much as possible at one sitting, and then closing the remaining portion in one or two more sittings. Again, Freund and von Rosthorn resorted to the extraordinary expedient of bringing the uterus out into the vagina through an opening in front of the cervix, and sewing the bare uterine body by its posterior face into the large vesical hole; or bringing it out topsy turvy through the posterior cul-de-sac and sewing its anterior face into the hole and so plugging it up. We think to-day we can avoid such extreme measures by dissecting the bladder free from its surroundings and closing it separately, as described. Macken-

rodt has been one of the most active propagandists for this operation in large fistulæ.



FIG. 525.—DOUBLE VESICO-VAGINAL FISTULA. I. When the fistulæ lie close together and in the base of the bladder, it is then best to cut the bridge and throw both into one. (E., Oct. 19, 1908.)

An interesting and sometimes very valuable plan is that of Dudley, shown in Figures 523 and 524. It can yield a perfect functional result.

MINUTE FISTULÆ.—A little fistula sometimes gives far more trouble than a big one. One reason for this is that the operator frequently treats it too lightly, and does not make sufficiently extensive denudations. Frequently a

little fistula is the residuum of many operations closing a large fistula. In such a case it often lies in the middle of a hard mass of scar tissue. In every small fistula it is best to dissect out the whole fistulous tract all the way to the bladder mucosa, thus avoiding the formation of diverticula or funnel-shaped processes on the bladder side. After the denudation is completed the closure is best made with fine needles and very fine chromic catgut suture. While such a

FIG. 526.—DOUBLE VESICO-VAGINAL FISTULA. II. Transformation of the two fistulæ, shown in last figure, into a single opening, by incision through the bridge of tissue separating them. The edges of this fistula were then denuded and the bladder freed for separate suture as already shown.

condition is usually cured, even if the patient is allowed to pass water from the first, the result is better still if a urethral catheter is inserted and allowed to remain in the bladder for at least 6 days.

MULTIPLE FISTULÆ.—Where there are multiple vesical fistulæ, usually one is large and the other small and close by. In such cases it is often well to throw the two or three into one, rather than attempt to close them up separately (Figs. 525, 526, and 527). A separate fistula into the urethra, or into the uterus, only complicates the case because it requires an additional operation to close it; preferably at the same time the vesico-vaginal fistula is closed.

INACCESSIBLE FISTULA.—Where the fistula is high up in the vaginal vault

and cannot be reached readily so as to do accurate work, and cannot be brought down by traction on the vaginal walls or by retracting the perineum, it may sometimes be reached by cutting down the vaginal orifice laterally, thereby gaining one-half inch or an inch (Fig. 536). If it still remains too far away

a suprapubic transvesical operation can be done, as by Trendelenburg (Figs. 528, 529, and 530). In such case the bladder may be opened above the pubis by a transverse incision through skin, fat, and deep fascia. It is not necessary then to cut through the recti muscles. These can be readily retracted when the bladder is exposed in the lowest tissues beyond the symphysis, opened widely from side to side, and the fistula exposed. By means of gut sutures the opening can sometimes be drawn up on a level with the skin surface of the abdomen.

FIG. 527.—DOUBLE VESICO-VAGINAL FISTULA.

III. Application of the first layer of sutures, closing the fistula shown in the last two figures. The suture material, of fine catgut, first closes the loosened vesical tissues, after which the vagina is closed in by a second layer of interrupted silkworm-gut sutures.

The edges are readily denuded and, in some cases, the bladder and vagina separated and closed independently. In others, one has to rely on the vesical closure alone. The same precautions as to deli-

cate instruments and suture materials must be taken as in other cases. The best suture material is catgut, and the suture should preferably be submucous. A continuous thread is preferable to the interrupted one, but is not always possible.

When the fistula is secured the bladder suprapubic opening should be closed, care being taken with the perivesical fascia. The space of Retzius is best drained with a small piece of iodoform gauze surrounded with protective, and the bladder should be invariably drained by leaving a mushroom catheter in the urethra for a week or more.

To suit the individual case the procedures are most variable.

When there is a vesico-uterine fistula or a vesico-utero-vaginal fistula which is inaccessible because of the fixation of the uterus by inflammatory disease

FIG. 528.—VESICO-VAGINAL FISTULA NEAR VAULT OF VAGINA RIGIDLY FIXED BY DENSE SCAR TISSUE. The scar tissue is due to removal of the uterus at a previous operation, which was also the cause of the fistula. It was found impossible to treat this fistula through the vaginal route. (C., Gyn. No. 6458.)

FIG. 529.—TREATMENT OF FISTULA PICTURED IN LAST FIGURE, THROUGH A MEDIAN ABDOMINAL INCISION. The bladder was opened on its posterior surface in the midline down almost to the fistula. A denudation was then made across the bladder, in front of the fistula, separating it and a small part of the bladder from the rest of the organ, as shown. Next the bladder was sewn up from top to bottom, as indicated by the stitches, leaving the fistula and the little patch of surrounding vesical mucosa wholly outside. A vaginal drain was then pushed up through the fistula to protect the pelvic cavity.

FIG. 530.—COMPLETED OPERATION ILLUSTRATED IN TWO PRECEDING FIGURES. The line of sutures in the bladder is protected by a drain passing from the vagina into Douglas' cul-de-sac through the original vesico-vaginal fistula.

(Figs. 531 and 532), if the operator first takes out the uterus above, freeing the bladder from it and from the upper part of the vagina in the usual way,

FIG. 531.—VESICO-VAGINAL FISTULA WITH PELVIC INFLAMMATION. I. Dense pelvic inflammation associated with vesico-vaginal fistula in a colored girl, seen through abdominal incision.

only taking great care not to tear it in the neighborhood of the fistulous opening, the loose bladder tissues can then be brought together and the fistula closed by an operation through the abdomen, where an operation through the vagina must necessarily fail (Fig. 533).

In one case, where the uterus had already been removed (Fig. 528) and numerous unsuccessful operations had been done from below, the abdomen

FIG. 532.—VESICO-VAGINAL FISTULA WITH PELVIC INFLAMMATION. II. Sagittal view of patient shown in last figure. The pelvic inflammatory condition, holding the uterus fixed and high up, prevented pulling the fistula down and operating by any of the ordinary procedures. We were thus forced to proceed by removing the uterus, with its tubes and ovaries, through the abdomen, in order to free the vagina and be able to get at the fistula.

was opened and, on failure to mobilize the bladder on account of the scar tissues on the pelvic floor, the bladder was cut into in the median line and the fistula exposed. It still being impossible to detach it from the bed of cicatrix, the incision was continued around the fistula on both sides in the form of a denudation about five mm. in width. The raw surfaces were then brought together across the gap and united by suture.

FISTULA ADHERENT TO THE PUBIC RAMUS.—A fistula adherent to the pubic ramus is best treated by dissecting the bladder entirely free at this point, so that it can readily be drawn down into the vagina and sutured. It is a mis-

FIG. 533.—VESICO-VAGINAL FISTULA WITH PELVIC INFLAMMATION. III. After removal of the pelvic structures from above, the bladder is easily separated from the anterior wall of the vagina, as shown. The clamp above grasps the posterior wall of the vagina and the sutures closing the fistula are already placed; this is done through the abdominal incision.

take to try here to denude the unyielding tissues *in situ* and to suture the movable parts up to the fixed point.

FIG. 534.—URETERO-VAGINAL FISTULA. The upper wall of the ureter is preserved; the lower wall is restored by denuding the vesical and urethral ends of the fistula, as shown at a and b, and bringing them together, as shown in figure to the right. As a rule the ureter opens into a larger vesico-vaginal fistula at a point much nearer to the urethra.

URETERS IN THE MARGIN OF THE FISTULA (Fig. 534).—When one or both ureters are in the margin of the fistula, caught in the scar tissue, this constitutes a serious complication. In the first place it has usually interfered with the function of the kidney of the affected side. Then, if the misplacement is not noticed, the ureter may be caught in the sutures and its lumen compressed or closed. We have known one case in which both ureters were thus included in the approximate sutures and the patient developed a pyelonephritis and died. The way to avoid this difficulty is to inspect the margins of the fistula narrowly, giving the patient 20 c. c. of 4 per cent. indigo-carmin intramuscularly, if necessary, to make the orifice more evident. Then, at the time of the operation, when the orifice is seen caught in the edge of the fistula, a catheter is passed up into the ureter for a short distance and the ureteral orifice is slit up on the bladder side for perhaps a quarter of an inch. This was recommended by Bozeman and has been done many times since.

FISTULA CLOSE TO THE PERINEUM.—When the fistula follows a vaginal hysterectomy, and the opening, usually a small one, is high up near the peritoneum, it is often a good plan to open the peritoneal cavity deliberately and widely from side to side as the very first step, thus freeing the bladder, and to draw its peritoneal portion down into the vagina. The fistula can now be easily closed and the bladder so adjusted, if need be, that part of its peritoneal covering forms a part of the upper vagina, while the peritoneal opening is partly closed and drained for 6 or 8 days. This bold method enables one to deal successfully with all of this troublesome class of fistulæ.

RUPTURE OF THE SYMPHYSIS.—We have seen 3 cases where the symphysis pubis has been punctured accidentally, with the formation of an extensive

FIG. 535.—URETHRO-VAGINAL AND RECTO-VAGINAL FISTULA AT THE SAME LEVEL. When the rectal opening is embedded in scar tissue, and where previous operations have been done, it is sometimes well not to follow the simpler plan of isolation and suture, as described in the text, but to split through the entire septum up to, through, and above the fistula. See Fig. 536. (Mrs. M., Jan. 11, 1902.)

vesico-vaginal fistula. In 2 of the cases which came under our care for operation, we succeeded without difficulty in restoring the symphysis by cutting down upon it, denuding the bone on the opposite sides and joining the bones

together with a stout silver wire. Union was not interfered with by the fact that in both cases sloughing bits of bone had to be cleared away first. In such a case it is best to clean out all the spicules of bone and to close up the vaginal fistula first before uniting the bones.

In one of these cases the bladder was torn almost into 2 parts, the right and left halves being joined only by a bridge of tissue and the vertex, the right urethra going with the right half of the bladder, and the left urethra remaining in the left portion. We succeeded here in closing the enormous rent in what was really a vesico-vagino-vulvar fistula in one operation. We then removed the necrotic bone and wired the symphysis. In spite of the fact that we were unable to cover up the edges of the wires completely, a perfect union was secured throughout the entire operation.

TORN PERINEUM.—If there is a complete tear of the perineum, it is a better plan to

FIG. 536.—URETHRO-VAGINAL AND RECTO-VAGINAL FISTULA. In order to close the recto-vaginal fistula shown in the last figure, the perineum and the recto-vaginal septum were cut through all the way to fistula, as shown in this picture. This incision gives a splendid exposure of the urethro-vaginal fistula, which is closed in the usual way. The recto-vaginal fistula is by this incision transformed into a complete tear, which was closed in a manner suitable to that condition.

close this completely, immediately after closing the vesical fistula, as neither of the injuries is likely to heal if the other is left to contaminate the wound.

RECTO-VAGINAL FISTULA (Figs. 535 and 536).—This is a rare complication of vesico-vaginal fistula, which is often best treated in a similar manner by

splitting through the coats of the vagina in its long axis, dissecting the rectum completely free from the vagina, and then inverting it a little on itself into the lumen of the bowel by 2 or 3 layers of continuous fine catgut suture. It is not necessary to close the vagina over the rectal wound. After this is done the vesical fistula may then be attended to. Unless both fistulæ are closed at the same operation, the one left open is apt to interfere with the union of the other.

PYELONEPHRITIS.—When there is a pyelonephritis, this should be treated by splitting up the ureteral orifice into the bladder so as to give free exit to the urine and get the orifice out of the region of the field of operation, treating the kidney, for some time before closing the fistula, by irrigations with boric acid solution or weak nitrate of silver solution (N. Bozeman). It is not safe to close a fistula in the presence of an existing renal infection.

URETERAL FISTULA.

An injury to a ureter in the course of an operation may end in a fistula, due to the severance of a part or the whole of the ureter in its continuity. Such an injury may also arise during childbirth, the rupture of the ureter in this case being associated with a deep tear extending up the lateral fornix from the cervix. Ureteral injuries commonly befall the pelvic parts of the ureter and, as a rule, are found somewhere in the neighborhood of the right or left broad ligament base. A surgical injury inflicted upon the ureter is due either to the cutting of the ureter inadvertently or to tying it, when after 8 or 9 days the ureter sloughs through and the upper end begins to discharge urine from the damaged kidney. Another common form of surgical injury is the more or less extensive sloughing of the ureter due to baring it and detaching it from its source of blood supply, with more or less injury of the vessels coursing down on its external coat. Such an injury as this more commonly follows the removal of a cancerous uterus.

If the abdomen and the vaginal vault are closed, the discharge may take place in the peritoneal cavity and the patient may die with the injury unrecognized. If there is a drain out through the abdominal wall or into the vagina the urine seeks this point for escape, forming a permanent fistula there.

There is established in this way a contracting channel in the tissues between the divided end of the ureter and the external orifice. A tendency of this channel is to continue to contract and close, until it becomes a mere pore, causing a hydro-ureter and dilated renal pelvis on that side, which often ends in an infection of the ureter and the kidney.

A rarer form of injury to the ureter is that in which it is punctured, or torn, or cut open on one side. There may then be a free escape of urine from that side for one or two weeks, when the wound closes and the patient recovers.

Almost all surgical ureteral injuries are of an avoidable nature. The experience and skill of the surgeon are demonstrated by greater care in tying off the uterine vessels with the certainty that the ureter is in no way involved.

Extreme care should be used in removing a cancerous uterus to avoid injuring the vessels of the ureter; we must also sedulously avoid any extensive denudation of the ureter. Wherever possible, the ureter must be left attached to the underlying tissues and simply rolled over toward the pelvic wall without freeing it.

Before operating, the surgeon wants to determine three things:

(1) Is the fistula really ureteral or is it a vesical fistula?

(2) On which side is the fistula situated; that is to say, which ureter is involved?

(3) What is the condition of the urinary tract above the fistula? Is the kidney worth saving?

Likewise, what is the condition of the opposite, presumably sound, kidney?

(1) **Is the Fistula Ureteral or Is**

It Vesical?—If a colored fluid (milk or anilin solution) is injected into the bladder, when the fistula is vesical, the fluid escaping through it will be colored, too. If, however, the fluid from the bladder is colored, while that escaping from the fistula continues clear, then the fistula must be ureteral.

(2) **On Which Side Is the Fistula?**—When the opening is vaginal, it usually lies on the affected side, but not always. Often the difficulties of the operation will suggest the side, but this is not sufficient. To make sure, the patient must be put in the knee-breast posture and the ureteral orifice inspected and catheterized. If the catheter passes freely up one side and enters but 3 to

FIG. 537.—SAGITTAL VIEW OF END OF URETER, BLADDER AND VAGINA IN CASE OF DOUBLE URETERO-VAGINAL FISTULA. The two orifices of the ureters are shown near each other. Both ureters were cut off in an operation for cancer of the cervix and debouched into the vault of the vagina. c represents the strip denuded across the vagina; a b the incision opening the bladder. Uniting the vaginal denudation c to the incision b, the fistulæ of the right and left ureters were successfully turned into the bladder.

5 cm. of the other, this determines the affected side. On watching the orifices the affected side appears dead, while the other, especially when the kidney has been stimulated by an effervescent saline water, spurts intermittently in a normal manner.

One of us (Kelly) had a case recently in which the surgeon was sure, on account of the difficulties of the operation, that the fistula lay upon the right side. The vaginal opening was in the right vault, but on catheterizing the ureter, it was found that the fistula was on the left.

(3) **The Condition of Both Urines.**—This is demonstrated by getting urine from the bladder to represent the sound side, and at the same time collecting urine from the fistulous side in a bed-pan or by means of a mushroom catheter placed in the vagina. It is safer to resist the temptation to catheterize the affected side. After such an act of catheterizing the patient is apt to have a chill and fever.

If the fistulous side is badly infected, and it is important on account of some defect in the other kidney to save the fistulous side, then one should freely dilate the opening up into the ureter and utilize it as a means of irrigating the kidney daily with a nitrate of silver solution (say 1 to 1,000), at the same time giving 20 to 30 gr. of hexamethylenetetramin.

Operation.—One of two forms of operation may be chosen: either anastomosis of the ureter into itself or into the bladder, or removal of the kidney. If there is a bad infection of the urinary tract and the opposite kidney is sound, it is a safer plan to do a nephrectomy than to try to save a seriously crippled organ, incurring the great risk involved by an operation under such conditions.

URETERO-URETERAL ANASTOMOSIS.—When the ureter is cut and the injury is recognized at the operation, as, for example, in one case where it was mistaken for a large vein (in the authors' experience), the best plan of treatment is to graft the upper end at once into the lower. This can be done in the

FIG. 538.—COMPLETION OF OPERATION SEEN IN LAST FIGURE. The small piece of the vagina, containing the end of ureter, is turned into the bladder by uniting the transverse incision in the bladder with the posterior denuded vaginal surface (c to b). The sutures at a are simply to stop the bleeding.

following simple manner: The lower end is slit a little on its upper side, the mucosa is trimmed off from the edges so as to increase the raw surface, and stretched a little to enlarge its caliber. Then a suture is made to transfix the divided upper end, both ends of which are passed through the eye of a blunt needle. The needle thus armed is now carried down the lumen of the lower end and brought out through its wall from 1 to 5 mm. distant from the orifice. By means of this traction suture the upper end of the ureter is now pulled well down into the lower end, and held *in situ* while the edges of the lower end are

sutured carefully on all sides with very fine silk or chromic gut to the upper end; then the ureter may be further fixed in its place in the pelvis by a few delicate sutures passed with a fine needle. A drain is always introduced afterwards, either up into the abdomen or down into the vagina. It must never rest directly upon the sutured ureter.

URETERO-VESICAL ANASTOMOSIS.—

It is hard to find and utilize the lower end of the ureter some weeks after the original operation when it has been cut low down on the pelvic floor. The best plan is to draw the upper end down and anastomose it into the bladder at the nearest point; if possible, into one of the vesical cornua. When the ureter is a little too short, the bladder can be lengthened 2 or 3 cm. by freeing it laterally and pulling it up. This operation ought, when possible, to be done extraperitoneally through an incision about six inches in length in the semi-

FIG. 539.—URETERO-VAGINAL FISTULA.

I. Catheter inserted in fistula. The dotted line shows the location of the incision for dissecting out the lower end of the ureter and implanting it into the bladder. (See following figure.)

lunar line directly over the pelvis. Working out toward the iliac fossa and then pushing the peritoneum inward and continuing with a blunt dissection down to the floor of the pelvis, the upper ureter is finally reached and gently freed down to its extreme lower end, where it is detached from the fistulous tract. It is important in liberating it not to sacrifice any of the length of the ureter. Dissecting a little more, extraperitoneally, a blunt instrument such as a closed forceps is introduced into the

bladder through the urethra, and used to push the bladder up and back; sometimes it is well to make a transverse suprapubic opening into the bladder, when a pair of forceps is introduced and the bladder pushed forward to the ureter at the point lying nearest to it. By cutting carefully through the coats of the bladder, the mucosa can be pushed out beyond the muscular walls, and then incised, while the ureter, which has been slit up a little to enlarge its lumen, is grasped and drawn well into the bladder. The first step is to fix the vesical mucosa to the wall of the ureter by fine catgut sutures. The muscular walls of

FIG. 540.—URETERO-VAGINAL FISTULA. II. The larger figure shows an opening in the bladder through which the free end of the catheter has been conducted and then brought out through the urethra, by means of the open-air speculum. The lower end of the ureter is dissected free for a little distance. It is then drawn into the bladder by means of traction sutures placed as shown in the smaller drawing. It is well to add another stitch or two to hold the ureter securely in place.

the bladder are then sutured to the walls of the ureter by fine interrupted silk sutures on all sides. After this the bladder is drawn up under the ureter, which lies in it as in a bed, and attached by several sutures. The downward pull of the bladder may be relieved by suturing it also to the pelvic wall. The wound is then carefully closed with a drain.

Uretero-Vaginal Fistula.—A vaginal ureteral fistula may be turned into the bladder by means of an operation devised by Mackenrodt, that is called en-

tropionizing. A small opening is made into the bladder close to the fistula, an incision is then made through the thickness of the vaginal wall around the fistulous opening, forming a collarette, which is freed enough to turn it into the adjacent bladder opening and held there by sutures.

In a case where there were two uretero-vaginal fistulæ at the vaginal vault, (Figs. 537 and 538), one of us (Kelly) succeeded in turning both into the bladder by cutting into the bladder transversely across the vagina in its upper

FIG. 541.—URETERO-VAGINAL FISTULA. III. Final step of the operation shown in the preceding figures. Closure of the vaginal wall over the freed ureter by interrupted sutures. The ureteral catheter may be left in place with advantage for two or three days.

portion, then connecting the ends of the incision by denuding a strip across the vagina posteriorly behind the fistulæ. Upon uniting the cut bladder wall to the posterior vaginal wound, both fistulæ were turned into the bladder without touching them, making a sort of a colpocleisis of a limited portion of the bladder.

The entire procedure of finding, locating, and treating a fistula of this kind is illustrated in Figures 539-541.

If the ureter cannot be dissected out, it may be connected with an opening in the bladder as shown in Figure 542. In all these cases where there is any infection, or where the excretion of urea is low, it is best not to waste time doing

anastomosis operations, but to remove the kidney at once, provided the other kidney is normal or nearly so.

URETHRAL FISTULA.

When the urethra opens into the vagina the fistula may be either simple or complicated. A simple fistula, looking more or less like a punched-out hole, is easily closed by putting a medium sized soft rubber catheter through the urethra into the bladder, and with this as a guide freshening up the fistula's edges and closing it. The catheter prevents any tendency to constrict the urethral caliber.

If there is plenty of tissue and the sides are easily brought together, a direct peripheral denudation may be made and the tissue drawn together from side to side or, often better, in a fore and aft direction, leaving a line of union transverse to the axis of the vagina. If the neck of the bladder seems to be involved, great care must be taken to close with flaps from the vaginal mucosa and to sacrifice no tissue.

Where there is complete loss of tissue across the urethra, restoration can be accomplished by splitting the edges of the upper and lower portions; and then uniting them by sliding them together and suturing end to end. A semi-circle of interrupted fine chromic catgut suture will do the work, if wounded surface is brought carefully to wounded surface. Use a staphylorrhaphy needle so as not to insult the tissues, and pass interrupted sutures not more than 5 mm. apart; often a continuous suture is preferable. It is not always necessary in such a case to pass a catheter. The patient may get up and void and, after a brief rest of a day or so, may go about her business, avoiding, of course, any local insults. If there is tension at the wound, tending to pull the coapted surfaces apart, it can be somewhat relieved by multiple small incisions in the vaginal tissues to

FIG. 542.—ANOTHER METHOD OF TREATING URETERO-VAGINAL FISTULA. Where not enough ureter can be freed to implant it into bladder, a wide circular opening is made in the bladder, as shown at B. An oval-shaped denudation of the vaginal wall is then made, to include both the ureteral orifice and the new opening into the bladder. A little strip of vaginal mucous membrane, shown between Ur and B, is left intact, and forms the lower end of the new ureteral canal. A renal catheter, inserted into and brought out through the opening in the bladder, is carried up through the ureter, as shown in the previous figures. The sutures, placed as shown, are tied.

either side of the line of sutures, the principle so frequently employed after removing the breast for cancer.

More extensive injuries of the urethra are of two sorts: splitting of the posterior wall—it may be in its whole extent; total or almost total destruction.

Every operation should aim to use to the utmost all the urethra which can be found. When the canal is merely split in its length, a good raw surface is secured on both sides by splitting the margins, which are then united, as we prefer, with fine chromic catgut suture, either interrupted or continuous.

Any extensive destruction of the urethra is a serious matter. If it is gone in its entirety, and the neck of the bladder, also, there is no way of operating by which any uniformity in success can be expected. One of us (Kelly) succeeded in one case by tunneling through the tissues under the symphysis, loosening up a tongue of vaginal mucosa with its base at the hole in the bladder, and then, by inverting the flap, pulling it through the tunnel, and fixing it there. Little fistulæ at the sides were closed; the canal, thus lined with mucosa, remained open, and, with a pessary, which was reinforced on its anterior bar so as to make a little pressure on the new urethra, permitted the patient to regain sufficient control to hold urine for several hours.

By utilizing the anterior vaginal wall, and the labia minora, a long, new spout-like urethra can be formed, terminating at the clitoris, but for the most part such urethræ have but cosmetic value, and the leak goes on just as before. Many similar attempts have been made to relieve this difficulty, but they are without exception, we think, more curious and clever than helpful to the patient.

We have succeeded in 2 other cases in restoring the urethra and urinary continence by taking flaps from the side of the vagina, denuding with extreme and minute care in the neighborhood of the neck of the bladder, and then sewing together the tissues from side to side with extreme delicacy so as to reconstruct the urethra and to use at the same time any possible remains of the sphincter muscle which might have been left behind, though it could not be seen. There is a hope of doing this when there is a little mucous furrow under the symphysis, which shows that, although the urethra have been injured extensively, the wall still persists.

It should be kept in mind that the entire urethra external to the sphincter can be destroyed without any discomfort to the patient, and with perfect vesical control; and, while sphincterless urethræ with good mechanical appliances can give comparative comfort, they do not compare with sphincter restorations in functional results. Where it is possible to restore sphincter union, the external canal may be neglected. Occasionally marked improvement of the sphincter after operation will follow electrical treatment.

CHAPTER XXXIV.

CYSTITIS.

Cystitis is the common name for a variety of inflammatory diseases of the bladder, in their superficial forms affecting the mucosa and the submucosa, and in more advanced stages invading the muscular coats, also. A cystitis may be localized in a particular area in the bladder, or it may be more or less generalized, and in the most advanced cases may even involve the entire organ; in the majority of instances it is patchy and restricted.

ETIOLOGY.

There must be at least two factors concerned in the causation of a cystitis: one, the infecting organisms; the other, a trauma or a condition of lowered resistance which affords them a nidus for development. Neither of these factors alone is sufficient to set up an inflammation. It has been repeatedly and abundantly shown by experiment that the mere introduction of micro-organisms will not cause inflammation or even a passing reaction; large quantities of bacteria have been injected into the bladder by the urethra, but they have invariably been washed out again with the next act of urination without detriment to the organ. Again, it is a matter of daily note that in infections of the kidney enormous quantities of micro-organisms may be discharged down the ureter and lie in the bladder until they are passed out by the urethra without damaging the bladder at all. When an infection does take place in this way, it would seem to occur oftenest by irritation of the area nearest the ureteral orifices by toxins, thus establishing a *locus minoris resistentiæ*, which is then followed by the invasion of the bacteria. Furthermore, a traumatism, as at childbirth, or the lesions made by surgical instruments, will never alone evoke a cystitis. However, if traumatism is repeated, sooner or later the micro-organisms from the neighboring bowel, or perhaps from the circulation, find a nidus, and an infection is started which may continue indefinitely.

Conditions predisposing to the localization of an infection in the bladder are: exposure to cold, exhaustion, irritating substances taken by the mouth, pro-

longed retention of the urine, as from stricture or the pressure of a tumor, the attrition of a calculus, tumor of the bladder with the accompanying strangury and hyperdistention, inflammatory conditions in the cervix uteri or in the Fallopian tubes, or an inflamed and adherent bowel. It used to be common to see a cystitis spring up during convalescence after an abdominal hysterectomy for fibroid tumors. We once examined one of these cases and found that the whole posterior surface of the bladder was thrown into ridges infiltrated with blood, due to the method of detaching the bladder from the cervix by rubbing it off with a piece of gauze. All that was then needed to produce a troublesome inflammation was two or three catheterizations! We now avoid touching the bladder at all and almost try not to see it.

The infecting organisms may enter the bladder from the kidney above—as in a descending tuberculosis, or in a typhoid case where the organisms are filtered out through the kidneys and lodge in the bladder—or the entrance may be effected through the blood. The latter method of entry is rare, seen perhaps in some cases of acute cystitis springing up in the course of infectious diseases and difficult to demonstrate. Again, the entrance is through the contiguous tissues from an infected ovarian or a dermoid cyst, or from an adherent bowel which perforates the bladder and pours in its irritating secretions, setting up a violent inflammation. Lastly, the urethra is the great portal of entry for all gonorrheal infections of the bladder, as well as for those lamentable cases which date from the introduction of a contaminated catheter. It is important in every record kept by specialists to state, when possible, the character of the invading organism or organisms. We do not mean to say that it is a *sine qua non*, for it cannot always be done, as a negative report often comes back from a first-class laboratory. We are further hindered by the fact that anaërobic organisms are sometimes present which are not readily recognized. The discovery of the germ does not necessarily influence treatment largely at the outset, especially in the hands of the general practitioner, but if the case defies his efforts to give relief, then it does make a great difference if the germ can be named and followed up in the further management of the case.

Those who have followed the history and the literature of cystitis for the past twenty-five years must have been appalled by the multiplying strange names of new bacteria cropping up, especially in French and Danish clinics, and more appalled still by the great diversity of opinion among the specialists exploiting this new field with such sportsmanlike zeal. It is satisfactory at least to be able to say that most of these weird organisms have taken off their masks and proven to be various forms of our old enemy the colon bacillus, for with this simplification of classification the difficulties have largely vanished.

The organisms commonly found are the tubercle bacillus, the gonococcus, the colon bacillus, the typhoid bacillus, the staphylococcus, the streptococcus, and the bacillus pyocyaneus.

Mixed infections are often grafted onto the tubercle bacillus, both in the kidney and in the bladder, giving rise to the most distressing forms of cystitis. Streptococci and staphylococci are apt to give way to a colon bacillus infection, which is the commonest of all.

One rule may be laid down in all cases for the guidance of the general practitioner: If an infection of the bladder does not clear up promptly, then the character of the organisms ought to be determined. This is, of course, a necessity, if vaccines are to be used in the treatment.

When a patient suffers from an acid cystitis with only a little fever and a little pus in the urine, the infection is apt to be tuberculous and the primary focus is in the kidney. Alkaline, ammoniacal cystitis is only seen in women when there is a sloughing mucosa or a sloughing bladder tumor; it is far commoner in men, and was probably much oftener seen by men of Gross's, Agnew's, and Ashhurst's generation than it is to-day.

PATHOLOGY.

Both the gross and microscopic anatomy of inflamed bladders vary immensely with the kind of infection, its stage, and its location, as well as with various coincident factors such as retention and imperfect trophic conditions.

In acute cystitis there is comparatively little autopsy or surgical material at hand, with the result that studies have been infrequent. Motz and Denis (*Ann. d. mal. d. org. génito-urin.*, 1903, xxi, 898) have contributed some valuable observations from a study of 14 specimens. They have noted the gross appearances of the mucosa so familiar to every cystoscopist; that is, the universal reddening, the dilated, arboreal-branching blood vessels, the thickening, the ecchymoses, and erosions. They further note that in acute cystitis there is practically never involvement of the muscle and perivesical tissues. The lesions start in the epithelium, extend into the underlying mucosa, and then into the submucosa. In the beginning there is the dilatation of the blood vessels and infiltration with polymorphonuclear and plasma cells (Fig. 543). A little later a marked proliferation of the blood vessels occurs and often focal accumulations of leukocytes, making little abscesses. The mucosa is practically never adherent to the submucosa. Healing takes place first in the superficial layer, with the disappearance of inflammatory products as well as of new-formed vessels. Contrary to the general description there is little loss of epithelium. This

is principally a post-mortem phenomenon. The musculature is rarely hypertrophied.

In chronic cystitis the variety of lesions is remarkable. The most complete recent literature, as well as splendid investigative work, can be found in the

FIG. 543.—SECTION THROUGH PART OF BLADDER WALL, SHOWING CHANGES IN ACUTE CYSTITIS. The large spaces in the epithelial layer are filled with polymorphonuclear leukocytes. The underlying tissue shows a lesser degree of infiltration with leukocytes. The blood-vessels are greatly dilated. This is an early and mild stage of acute cystitis. x 220 diameter. (Gyn. Service, J. H. H., Gyn. Path. No. 3849.)

articles of Stoerk and Zuckerkandl (*Ztschr. f. Urol.*, 1907, i, 3) and Hallé and Motz (*Ann. d. mal. d. org. génito-urin.*, 1902, xx, 19, 129).

Where retentions occur, such as are typically present in enlarged prostate and in lack of trophic control, as in tabes, the bladder is distended, there are marked trabeculae, and great thickening of the muscular coats, in addition to the changes incident to the chronic inflammatory process.

In the uncomplicated chronic cystitis the bladder is diminished in capacity, is no longer capable of wide variations in distention, and has markedly thickened walls. The mucous membrane is generally slate-colored, with spots of reddening. The smooth, velvety normal surface becomes leathery and granular, being thrown into folds and irregular protuberances by granulation tissue and

a

b

c

FIG. 544.—SCHEMATIC REPRESENTATION OF DOWN-DIPPING OF EPITHELIUM SIMULATING GLAND STRUCTURE. (From Stoerk and Zuckerkandl.)

ulcers. Frequently patches of leukoplasia are seen. This latter condition is especially common in patients of reduced general health. There is also the formation of cysts, the so-called cystitis cystica, a condition first described by A. S. Dogiel (*Arch. f. mikr. Anat.*, 1890, xxxv, 389).

The microscopic appearances are most interesting. The surface epithelium is nearly always absent in part. The blood vessels of the mucosa and the submucosa are dilated. There is a great extravasation of polymorphonuclear leukocytes and hypertrophy of plasma cells. This inflammatory tissue extends through the muscle coats and into the perivesical tissues. In very advanced cases the muscle is largely replaced by fibrous tissue, and the perivesical tissue

may show the fibro-lipomatous change so common in old chronic inflammations. In leukoplakia the typical lesion is a transformation of the epithelium into many layers similar to the horny tissue of the skin.

Stoerk and Zuckerkandl (*loc. cit.*) have shown how the epithelium dips

FIG. 545.—EXTENSIVE PSEUDO-GLAND FORMATION IN A CASE OF CHRONIC CYSTITIS CYSTICA. (From Stoerk and Zuckerkandl.)

down into the submucosa, how it breaks in the center and forms cysts (Fig. 544), and how in some cases typical glands are formed (Fig. 545), in every way resembling the glands of the intestinal tract. These glands may be multiple branching affairs. They are frequently the site of the development of carcinoma, and afford a rational explanation for the adeno-carcinoma of the

bladder. The cysts to which they give rise vary in size from a pin-point to structures as large as a pea. In the female alone the breaking down of these

FIG. 546.—EXTENSIVE CALCAREOUS DEPOSITS IN BLADDER IN CASE OF CHRONIC CYSTITIS.
The deposit is in the form of a ring about 1 cm. in width and extending all the way around the bladder as shown. Smaller deposits lie behind the ureteral orifices. The base of the bladder, as well as the dome, is free from all deposit. The small drawing above shows a speculum view of the internal urethral orifice in the knee-chest posture. The crescent below includes part of the calcareous ring; above is seen the normal bladder. (Mrs. G., June 16, 1906.)

cysts is frequently followed by ulceration and the deposition of calcium salts, giving rise to the so-called incrustation or stalagmite bladder (Figs. 546 and 547).

SYMPTOMS.

The characteristic symptoms of a cystitis are pain and dysuria; added to these there is a desire to urinate frequently, with more or less local tenderness, and a sense of pressure or bearing down in the lower abdomen. One occasionally sees cases where the frequent urination (pollakiuria) is absent and the patient urinates with only average frequency but suffers in the act. The

urinary distress is marked in the beginning, but there is only a slightly increased frequency, which gradually grows worse until, in the course of a few months, the case may become one of incessant strangury. Again, the symptoms may represent the subsidence of an acute attack which lapses into a chronic one, with less-

ened, but still marked frequency. The stress of the pain falls often in the night, when the poor sufferer becomes worn out with her vigils and the necessity of getting up to urinate. The worn, emaciated facies of the bad chronic cystitis patient is characteristic. We have known some who simply spent most of their time sitting on a chair with a hole in the seat over a pot. Again, a constant spasmodic condition of

FIG. 547.—CALCAREOUS DEPOSITS ON BLADDER WALL. Two cystoscopic views of contiguous portions of bladder. (H., Feb. 24, 1900.)

the bladder causes a dribbling indistinguishable at first from the simpler forms of incontinence. There is always some pus in the urine, so small in amount at first that it may be found only after collecting a considerable quantity for examination. With the continuance of the disease the pus increases, until the urine is murky and throws down a heavy sediment of pus, mucus, and epithelial débris.

DIAGNOSIS.

The diagnosis of a cystitis is commonly made when a patient suffering from frequent and painful urination is found to pass urine containing pus, but this is not sufficient. The diagnosis reaches complete certainty when the inspection of the interior of the bladder reveals the inflamed condition to the eye. A symptomatic diagnosis can only inform us in a generic way that the patient has a cystitis, but it tells us nothing specific as to the extent or the grade of the disease. If the urine is loaded with pus, we infer that the disease is extensive, but this inference is not so certain, as the pus may come down from a bad kidney.

The method of direct examination consists in inspection and palpation; by palpation we recognize vesical tenderness and, in advanced cases, an infiltration of the bladder walls. Palpation is best made bimanually with a finger in the vagina and a hand on the lower abdomen; or, in a man, with the finger in the rectum. The bladder should be examined when empty and again when moderately full. Particular attention must also be paid to any perivesical foci of

inflammation, and above all to the condition of the ureters in their terminal portions. Any cord-like thickening here should at once arouse suspicion as to the integrity of the kidney above it.

The capacity of the bladder ought to be measured in every case. This determines not so much the degree of contraction as the question of its intolerance. A normal bladder ought to hold 300 to 500 c. c. A really contracted, non-distendable bladder is rarely seen in women.

Only by cystoscopy can we determine and chart out the exact site of the lesions, their extent, and the degree of inflammation present (Fig. 548). The urine must be examined for pus, bladder epithelium, crystals of salts, bacteria, and albumin. In cystitis the albumin usually forms a small, delicate ring with the nitric acid test. If there is a well-defined ring, a kidney is probably involved and ought to be investigated (T. R. Brown). We wish to emphasize for the general practitioner the extreme importance of a direct inspection of the bladder in all cases of cystitis which do not clear up promptly after a brief period of treatment; this is the more urgent because all cases of cystitis are readily controllable in their earlier stages. It is also the habit of not a few physicians, we fear, to label a case cystitis simply because the patient complains that she has to urinate frequently (pollakiuria). If, on top of this diagnosis, there follows a regimen of catheterizations and irrigations, a harmless affection, without any underlying basis of inflammation, may be converted into an actual infection even of a severe grade.

FIG. 548.—INSPECTING AND PLOTTING OUT A FOCUS OF DISEASE IN BLADDER WITH OPEN-AIR CYSTOSCOPE. The cystoscope is introduced so that it almost touches the part of the bladder wall under inspection. By moving the speculum across the field a series of views is secured which, taken together, covers and measures accurately the desired area. In the upper figure an irregular patch of ulceration under inspection has thus been plotted out and reconstructed on paper by jotting down the individual views, as shown. By this means not only the outline, but the size can be accurately determined and recorded.

The Examination by Cystoscope.—This may be made with or without anesthesia. Where the urethra is more or less dilated from repeated catheterizations, when the patient is self-controlled and tolerates an examination well, it may be made with entire satisfaction without any anesthetic, that is to say, in nine cases out of ten. A bad cystitis, however, with extreme sensitiveness and much strangury, is best investigated under profound anesthesia; at any rate the first searching examination is best made in that way. We prefer to use the open-air cystoscope, as the bladder, even under the deepest anesthesia, may be utterly intolerant of any forced distention. After the patient is completely anesthetized, she is placed in the knee-breast posture and held there by an assistant sitting on each side with an arm thrown over the back and around the waist, and one hand gripping the knee in the popliteal space, in this manner holding the thighs vertical. The back must be well curved in, the head low, and the face turned to one side. The examiner now lets air into the vagina to drop the base of the bladder to the plane of vision; he next cleanses the external urethral orifice and introduces the conical calibrator, and, giving it a slightly boring motion, uses it to enlarge the external urethral orifice up to 10 mm. in diameter. The No. 10 cystoscope is then introduced, and the obturator withdrawn; the air at once rushes into the bladder and distends it. This degree of dilatation is a good preliminary to any subsequent treatment. In some cases it may even be well to dilate up to 12 mm. in diameter. The examiner now reflects the electric light held just over the sacrum and proceeds to inspect the walls of the bladder in an orderly manner. If the little urine left in the bladder interferes with the view, it is readily sucked out with the evacuator. The first observation taken relates to the degree of expansion of the bladder. In an average case the posterior wall drops away from the anterior until it is distant about 6-7 cm. from the internal urethral orifice, easily measured on the speculum. When there is much inflammation, with an intolerant bladder, the distance may not be over 2 cm. The first point examined is naturally the area first visible, the posterior wall. An inflammation here is apt to extend to the right and to the left and out onto the base. The inflammation seems to lodge by predilection along the fold stretching from the right to the left cornu.

The middle or sagittal line of the bladder is an equator easily known and affords the most convenient point of description for lesions located on it or to the right or the left. The end of a speculum of known size can be applied to the lesions, and exact measurements made of their extent and irregularities (see Fig. 548). After describing any lesions on the posterior wall, the examiner then turns naturally to the right and the left lateral walls, and next to

the vertex of the bladder. Then, dropping the handle of the cystoscope, he looks up to the base of the bladder with its trigonum and the ureteral orifices and the area about the internal orifice of the urethra. This region needs especially careful examination, particularly in determining the exact location of any areas near to the urethral orifices. An abnormal ureteral orifice is more reddened than usual, and may be dilated, the site of ulceration, or depressed in a pocket, and always needs further careful study, for it is the sign manual of disease higher up. After completing the examination of

the base and of the trigonum, the speculum is then elevated to an extreme position and the retrosymphyseal area is examined. In our experience inflamma-

tory lesions are not so often found here.

The lesions of cystitis thus found are not often universal, as we used to imagine them a long generation ago, before the day of cystoscopic examinations. The picture of cystitis then in the mind of the surgeon was one of a uniform reddening of the whole of the lining of the bladder. Nowadays, even when one does find such an extensive reddening of the mucosa, there is also some intense localized focus or

FIG. 550.—CALCAREOUS DEPOSITS SURROUNDED BY MARKED INJECTION OF BLADDER. Immediately in front of the largest patch is a vesico-vaginal fistula. (Miss M., Feb. 28, 1900.)

ulcer, which is the original seat of the disease (Figs. 549 and 550).

In general the characteristic lesions of the cystitis are a reddening of the

FIG. 549.—ULCERS ON TRIGONUM. Note relations to ureteral orifices and urethra. (From John Neff.)

mucosa, a disappearance of the finer vessels and then of the larger vessels, both seen so conspicuously in the normal bladder dividing it up like a landscape well watered with streams. When the vessels disappear they leave behind only an irritated, angry, reddened surface. Here and there may be spots of ulceration with accumulated pus and little hemorrhagic areas. The disease is more

or less patchy in extent; the patches are irregular, rounded, and crenate, and more or less confluent. Again, the infection is petechial, and there are little ulcerated spots, centers of an intense inflammatory zone, like so many little volcanoes belching out fire.

When the ulcerated area heals, it contracts and assumes a linear or linear-radiating form (Fig. 551); and in time the line of the old ulcer stands out a sharp falciform ridge, dividing the bladder into conspicuous deep loculi, seriously interfering with its expansion.

Ulcerations along these

FIG. 551.—LINEAR HEALING ULCER ON POSTERIOR BLADDER WALL, AS SEEN THROUGH CYSTOSCOPE. The surface of ulcer is yellowish white; surrounding this is an intensely red zone about 3 mm. wide. Beyond this zone are large injected blood vessels, all apparently radiating from the ulcer. The positions of the ureteral orifices are shown by the crosses above. The smaller drawing to the right shows two small round ulcers in the same bladder. (From P. Harris, Jan. 19, 1897.)

sickle-shaped ridges are peculiarly slow in healing and sometimes give rise to most troublesome bleeding. When they heal they look so avascular that it is a temptation to cut them on sight.

Catheterization.—The important query often arises whether it is advisable to catheterize one or both ureters in the presence of a cystitis. We have catheterized literally thousands of times under such conditions and have never yet seen any regrettable accident. We do not, however, mean that the catheter is to be passed up in any case without unusual precautions.

First of all, if one ureter is manifestly diseased, we catheterize that by preference. If it is necessary to catheterize a sound ureter, clean out the lumen of the speculum with a silver nitrate solution (2 per cent.), and apply the solution around the orifice of the ureter before slipping in the catheter. We do not leave the catheter in any longer than necessary.

A satisfactory analysis of urine from the uncatheterized side can be made from urine collected from a catheter inserted into the bladder. The delay in the bladder is so short that the contamination is minimal.

Differential Diagnosis.—A differential diagnosis must be made between cystitis and an irritable bladder or a hyperemia of the trigonum. In an "irritable bladder" there is no inflammation and there is no pus in the urine, and no inflammatory area is seen. In hyperemia the trigonum is more or less extensively reddened and painful to touch, and the patient passes water frequently, but either no pus is found or, at most, a few leukocytes are discovered in a 24-hours' specimen. Such cases bear no relationship whatever to true cystitis until they are maltreated; if, however, they are subjected to active local treatment an obstinate, severe cystitis may be grafted onto the milder malady. A bacteriuria is distinguished from cystitis by the absence of local lesions. We must also distinguish cystitis from a pollakiuria due to pregnancy or the pressure of a tumor on the bladder. Again, the absence of changes in the urine and local changes in the bladder are the diagnostic marks.

FIG. 552.—ENORMOUS HYPERTROPHY WITH EDEMA OF ANTERIOR VAGINAL WALL SIMULATING CYSTOCELE. This condition is due to a cystitis. (Miss F., Nov. 27, 1895.)

We call attention to these obvious matters because some of our multi-specialist physicians are inclined to overlook the microscopic examination of the urine and the demonstration of pus as essential in the diagnosis.

In making a diagnosis of cystitis it is always best to try to distinguish at once between those which may be called inflammation pure and simple and those which are dependent upon some obviously provocative factor, such as a stone, a tumor, or a pyuria from the kidney, or a fistula from a neighboring organ.

There is also a desquamative affection, marked by the presence of many minute clumps of epithelium floating in the urine, which may persist long

after the inflammation and the organisms have disappeared; here, too, the microscope and inspection allay all doubt.

In order to distinguish the organism which is the underlying cause of the persistence of the inflammation, one must, first of all, recall the fact that a persistent acid pyuria, with a rather small quantity of pus and some little fever, is apt to be a tuberculous affection.

The organisms should be taken for cultural purposes either by a sterile catheter, after cleansing the urethral orifice, or directly from the bladder through a cystoscope.

An interesting change sometimes observed with a cystitis is shown in Figure 552. Such an appearance on ordinary vaginal inspection suggests a simple cystocele or a urethrocele, but on passing a catheter the tissues are found edematous and hypertrophied.

TREATMENT.

GENERAL PRINCIPLES.

It is important in treating cystitis to distinguish in the first place between the acute and the chronic forms and to isolate, when possible, the bacteria causing inflammation. One ought, in every case, to start out with a well defined progressive plan of treatment. It is a common and grave error to adopt some one course and to stick to that for months or even for years, irrespective of the results. We have in mind here more particularly those physicians who use irrigations of the bladder to the exclusion of all other methods. In a puzzling case it may be stated as an important principle to proceed tentatively from the milder to the more drastic measures.

Combinations of several methods are often necessary, as, for example, simple hygiene and medication by mouth, combined with local treatments. Another valuable dictum is that a large percentage of cystitides owe their origin and their maintenance to an infected kidney, and the bladder cannot be cured until the diseased organ above is cured.

In all forms of treatment, as far as possible, the patient should be spared unnecessary suffering; any line of treatment which is excessively painful must, as a rule, be abandoned for something less drastic and distressing. As a rule, more harm than good is done by very painful treatments. The length of time necessary to effect a cure depends entirely upon the cause and the extent of the disease. A patient with a calculous cystitis is relieved of her suffering and

quickly cured by the simple removal of the stone. Chronic cases which have already been under treatment for years may require several months or longer to secure relief. In some of our earlier chronic cases we even spent several years in eradicating the disease; we did not then always know what were the best steps to take at first, nor did we always know so well when it was wisest to abandon one form of treatment and to adopt another more radical one.

ACUTE CYSTITIS.

In acute cystitis we are more limited in our methods of attack than in the chronic forms. Here, however, simpler measures are effective, and with proper treatment the affection tends to run a self-limited course. The methods of treatment employed may be grouped as:

Sedative

Medicinal

Hygienic

Irrigations

Instillations

Drainage (as a last resort; by the vagina in women—suprapubically in men).

The patient ought to go to bed and stay there until the acute part of the attack is over. Small doses of morphia may be necessary to relieve pain. Abundance of water, preferably one of the alkaline waters, should be given, as it has a distinct sedative effect. Copaiba capsules should be given in gonorrheal cases. Urotropin (hexamethylenetetramin, U. S. P., cheaper) is particularly valuable in colon bacillus and typhoid infections, not infrequently serving to cut the disease short. If the bladder is not too tender, it should be irrigated once or twice a day with a warm boric acid solution, distending it as much as the patient can stand without marked discomfort. At the end of the irrigation a teaspoonful of 50 per cent. solution of argyrol may be thrown into the bladder and left there (instillation). Protargol is valuable when used in instillation, of a strength varying from 1 to 10 per cent., or stronger, according to the tolerance. If the trouble inclines to linger after using these ordinary measures, a vaccine may be made by culture from the organism and injected. If the case tends to run a more protracted course, it will be well to put the patient under a gas anesthetic, to examine thoroughly with the cystoscope, and then to drain the bladder for several weeks by making a vaginal incision.

THE TREATMENT OF CYSTITIS BASED ON THE FORM OF THE INFECTION.

A point often of value is the treatment of the cystitis from the standpoint of the character of the infecting organism, by using some bactericidal agent known to be inimical to the particular form of infection. The general practitioner, living at a convenient distance, may take a fresh catheterized specimen of the urine to a pathologist to examine. A doctor living in the country will do best to boil a bottle and its cork and then, after washing the urethral orifice, to draw the urine directly into the bottle through a sterile catheter, to cork it and send it off to the nearest competent pathologist.

The organisms which it is valuable to know in this connection are these:

- Tubercle bacillus
- Gonococcus
- Colon bacillus
- Typhoid bacillus
- Proteus
- Staphylococcus
- Streptococcus.

We are able here to distinguish five different forms of treatment, according as they are applied to one or other of these groups of infecting organisms; for example, when tubercle bacilli are found, the general practitioner may safely conclude at once that the trouble is quite certainly renal in its origin and surgical in its treatment. Gonococcal cystitis will disappear under the use of oil of copaiba, or the oil of sandalwood. The colon bacillus and the typhoid bacillus are more affected by urotropin taken in doses of 3 to 15 or 20 grains 4 times a day, according to the toleration—big doses, if they do not irritate the bladder, are, as a rule, most efficient. The diphtheria bacillus (rarely found) calls for the administration of antitoxin. If the proteus is found and the urine is alkaline, give benzoic acid in doses of 10 to 15 grains to make it acid, and then follow this with urotropin. Staphylococci and streptococci also call for the use of urotropin.

TREATMENT OF CHRONIC CYSTITIS.

Chronic forms of cystitis are among the most distressing ailments the physician is ever called upon to treat. The pain is peculiarly wearing, as there is no let-up night or day. Judgment here is often difficult, for the various forms of treatment call for considerable practical skill in applying them to an indi-

vidual case. It may, however, be said that almost all cases, no matter how inveterate, can be cured in time, excepting those of advanced tuberculosis.

Categorically stated, the methods of cure in chronic cystitis are:

1. Elimination of a renal source of infection.
2. Hygiene.
3. Medication.
4. Irrigations.
5. Instillations.
6. Distentions.
7. Topical treatments through the open-air cystoscope.
8. Curettage.
9. Drainage of the bladder by the urethra.
10. Drainage by a vesico-vaginal incision.
11. Tub treatment.
12. Excision of the diseased area.

In every case several of these methods are used simultaneously, and in each instance the physician must be ready to adopt another plan of treatment provided one plan fails after due trial.

1. **Elimination of Renal Infection.**—Before beginning the treatment of chronic cystitis, the question of the renal source of the infection should be decided by a preliminary cystoscopic examination. Not infrequently the fountain of the trouble lies above; this observation is common when the kidney is tuberculous, or when it contains a stone, or again when there is a chronic pyelitis. Under such conditions, all that the treatment of the bladder alone can effect is some illusory temporary amelioration of the symptoms. On the other hand, if we find that the trouble is due, say, to a light pyelitis, and proceed to treat the kidney by irrigations or even by drainage at the same time that the bladder is under treatment, the improvement is rapid and permanent. Sometimes a cystitis develops upon a bladder irritated by toxins poured down the ureter. Again let us say: In every case of cystitis have the kidneys in mind until it is proven that they are not at fault.

2. **Hygiene.**—Every cystitis patient needs rest, and does better for spending either all the time, or a considerable portion of it, on her back in bed. Food should be light and nourishing. Baths and massage keep the skin active and are most valuable adjuncts. The lower intestinal tract should be kept open. Patients who have the means at command, do well, as they improve, to drive out in the fresh air and to sleep out-of-doors.

3. **Medication.**—The object of internal medication is two-fold: first, to relieve the burning and pain and other symptoms; second, to destroy the in-

fecting organism. The older remedies, such as buchu, copaiba, and triticum, apparently gave some help, but are but little used now. In acute cystitis it is justifiable to employ the sedatives morphin and codein. They should never be used in chronic cases. A simple but sometimes very soothing preparation is that containing 20 gr. of potassium citrate and ten drops of a tincture of

FIG. 553.—IRRIGATION OF BLADDER THROUGH TWO-WAY CATHETER. The inlet flow should be larger than the outlet. By varying the height of the funnel, the irrigation can be carried on rapidly or slowly and with any degree of bladder distention desired. Care should be taken to avoid over distention.

hyoscyamus to the dose. This can be repeated every two or three hours, and should be taken with much water. The value of the urinary antiseptics dependent upon the liberation of formalin is fully discussed in Chapter XXIII.

Personally, in the great multitude of new preparations, we have seen nothing superior to the old hexamethylenamin. There are at least 50 combinations of this substance with other compounds, and new ones are coming out every year. They are all of marked value in the treatment of both acute and chronic cystitis.

4. **Irrigations.**—Irrigation is one of the oldest, simplest, and easiest ways of relieving a cystitis. The reason for its efficacy lies in the fact that by this means the bladder is cleansed of its accumulated toxic débris, which is not well discharged by the act of urination. The toxic substances developing in the

}

///

FIG. 554.—ONE METHOD OF IRRIGATING BLADDER BY MEANS OF TWO-WAY CATHETER.

urine of a cystitis patient, especially when ammoniacal, are often capable in themselves of perpetuating and aggravating the disease. It is, therefore, sometimes enough to wash the bladder out thoroughly once or twice a day to effect a cure. If the urine is acid, the bladder may be washed out with a borax solution, a teaspoonful to a pint of warm water; if it is alkaline, use a boric acid solution of half that strength. A pale pink solution of permanganate of potash

is sometimes serviceable; again, a weak solution of bichlorid of mercury, say 1 to 10,000 or 20,000, or a weak solution of carbolic acid, say 1 to 500, is serviceable.

A good way to irrigate is to take a funnel attached to a catheter by a rubber tube 2 feet long; fill the funnel and the tubing with the solution, and introduce the catheter into the bladder (Figs. 553 and 554), taking care not to let

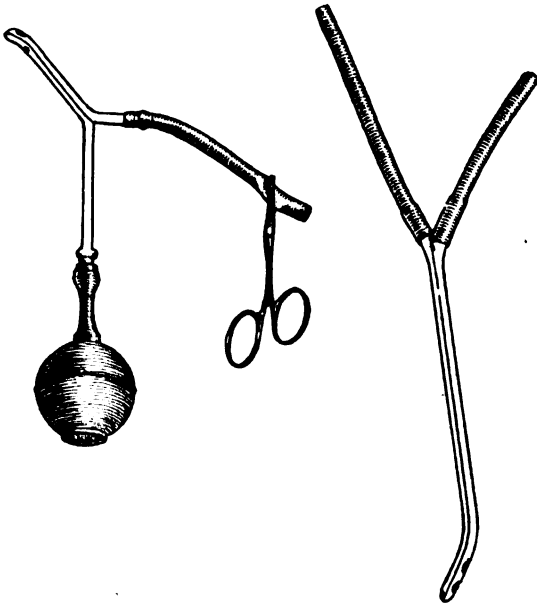


FIG. 555.—DICKINSON'S TWO-WAY CATHETER. After introducing the catheter into the bladder, the clamp is removed from the rubber tube, which permits the urine to escape. The clamp is then reapplied and the medicament in the bulb squeezed into the bladder.

any air get into the bladder to cause distress. The solution should be allowed to run in slowly and then to run out through the lowered inverted funnel. Repeat this several times until the fluid is clear. By raising and dropping the funnel rapidly, strong currents are created in the bladder which make the washing out more efficacious. After the first rinsing the same water may be run in and out two or three times. We believe that the efficacy of the irrigation, as of all intravesical treatments with large quantities of fluid, is much enhanced by using the solution as hot as the patient can bear it, say in the neighborhood of 105° F. The bladder may be irrigated in this way once or twice daily.

If the first treatments are painful it is well to give the last irrigation earlier in the afternoon to give the bladder a chance to quiet down before sleeping time. A good irrigating fluid is a simple, hot saline solution (a teaspoonful of salt to the pint).

5. Instillations.—An instillation is the injection of a medicated solution into the bladder with the intention of leaving it there for a longer or shorter time, with the object of sterilizing the urine or of acting upon the inflamed walls of the bladder. An instillation is not often used alone, but is more effective following irrigation, or irrigation with distention. The best solutions for instillations are nitrate of silver, from 1 to 1,500 down to 1 to 100;

argyrol, one or two teaspoonsful of a 30 to a 50 per cent. solution; and protargol in a strength of 2 to 10 per cent. Dickinson's syringe (Fig. 555) is a convenient instrument for emptying the bladder and injecting the medicated solution. It consists of a double glass catheter. The lower one empties the urine from the bladder; this is then stopped off, while the bulb is squeezed and the medicated solution contained in it is thrown into the bladder.

6. Distentions.—Progressive distention is perhaps the most important single form of treatment for the relief of bad cases of cystitis. The object of the distention is to eliminate the disease by stretching the bladder to the limit of its capacity, exercising its walls, and evacuating the fluid and cleansing it. Most chronically inflamed bladders cannot hold over 30 or 50 c.c. of urine. Cases of this kind call either for distention or, if that is intolerable, for an incision in the base of the bladder, draining and setting it at rest. We have cured many of these cases by a combination of irrigation, distention, and instillation treatments, and it is surprising what can be done with the coöperation of the patient in the hands of a nurse of endless perseverance, who knows what is to be accomplished and persists from day to day, stretching the bladder little by little, until it advances by degrees to 100, 200, and even 500 c.c. or more, when the cure is attained. In just these cases we always give more credit to the faithful nurse than to the doctor. At first cleanse the bladder by irrigating and distend it to a maximum several times; then, after emptying, inject 5 or 10 c.c. of argyrol or protargol solution. In order to assist the tolerance of the bladder we sometimes inject a 1 per cent. solution of cocain, leaving it there for 5 minutes, and then we begin the distention treatments. The fluid used in distention is either a one-half saturated hot boric acid solution, or a normal saline solution, or lysol, $\frac{1}{4}$ to $\frac{1}{2}$ per cent., or carbolic acid, $\frac{1}{2}$ per cent.

The apparatus used is a simple funnel connected with a glass catheter by a rubber tube about 4 feet long; there is a glass joint in the middle to show whether the fluid is running or not, and to reveal the presence of air. The first days or weeks of treatment are often discouraging to doctor, patient, and nurse. We have found it a help to make a chart like that shown (Fig. 556), graded from zero up to 500, and extending over a period of from 6 to 8 weeks. The tested capacity of the bladder is put down as the starting point in the first column, and then day by day, as the distentions are made, a mark is set on the chart opposite the corresponding figure. The patient in this way sees just what is wanted, she is encouraged by any little gains, and, above all, is inclined to permit the distentions to be carried a little further each time in order to make a gain.

These progressive treatments are of the utmost value in curing those cases which are commonly called "contracted bladders," which we will describe more fully later. Only a well trained nurse should be entrusted with this delicate

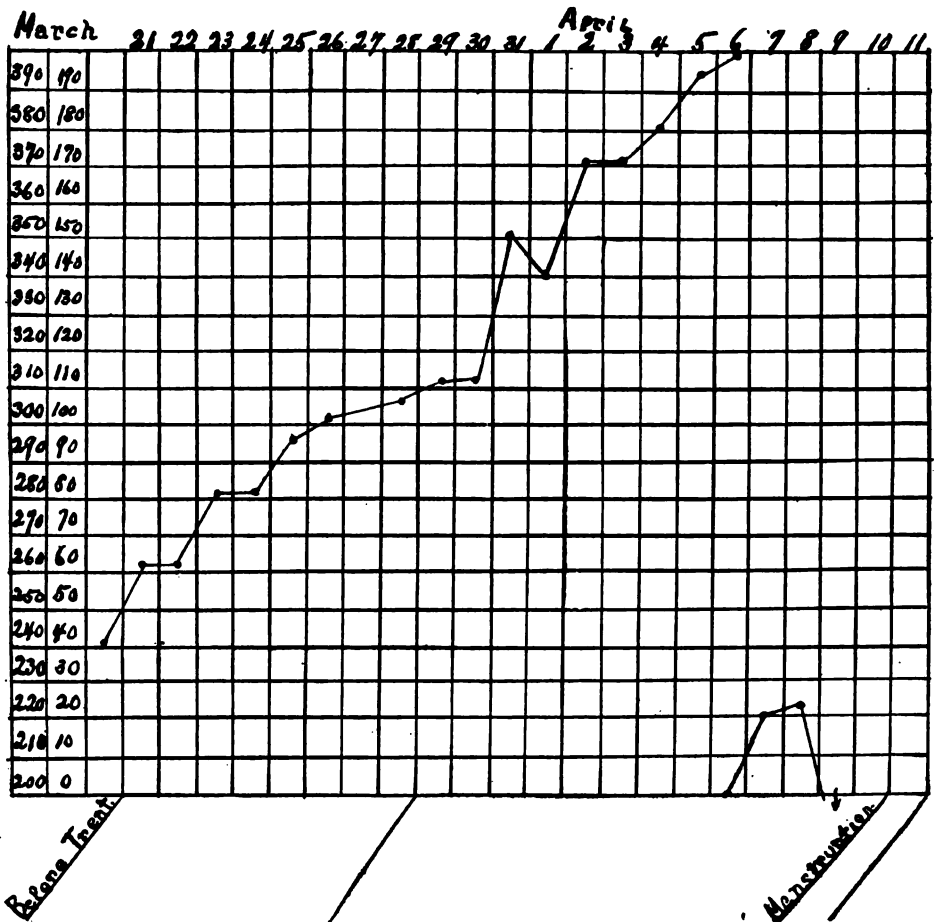


FIG. 556.—CHART SHOWING PROGRESS UNDER DISTENTION TREATMENTS. The chart is hung upon the wall in the patient's room to show the progress made from week to week under distention treatments in a case of severe cystitis with "contraction" of the bladder. It is best, as a rule, to take the chart down and to discontinue treatments over the menstrual period, as there is usually more or less falling back then.

treatment, calling for so much tact and judgment. The fluid should be introduced slowly into the bladder through the catheter, proceeding more and more slowly as the maximum is approached. It is well to distend the bladder in this way three or four times at each sitting. The chart here shown is from an actual case.

After expanding the bladder with a bland fluid and emptying it, it is often well to run in a weak silver solution, say 1 to 1,000, or 1 to 500, or stronger if the patient can stand it, and to leave this in for a few minutes or until the urine is passed; or again, after emptying the bladder, one may inject a few c. c. of an argyrol or protargol solution.

7. Topical Treatments Through the Open Air Cystoscope.—A topical treatment is the direct application of a medicated solution to the diseased area in the bladder without touching the sound tissues; this is done in the knee-breast posture through the open-air cystoscope. Such treatments are not serviceable in all cases of cystitis, but are best used where the cystitis is localized and there is no diffuse surrounding inflammation or thickening, and in the absence of excessive tenderness. Small areas of ulceration above the trigonum or on the posterior wall of the bladder are treated with advantage in this way. The best solution to use is nitrate of silver, making, for example, a few applications of a 5 per cent. solution, and repeating this at intervals of about 5 days with a 3 per cent. solution. The application is made by putting the patient in the knee-breast posture, introducing the No. 10 speculum, emptying the bladder of its urine if it interferes with the application, and then, with an applicator armed with a pledget of cotton saturated with the solution, or with the cotton pledget held in the grasp of an alligator forceps, making the application directly to the ulcerated surface, placing the cotton for a few seconds or longer against it. In this way the surface is whitened and the area sterilized for a time. Be careful not to have too much solution to run down over the sound tissues. It is an excellent plan, in treating larger areas in this way, to use what we call sequestration treatments. In doing this we apply the end of the speculum to the ulcer, or a part of it, so as to shut it off completely from the rest of the bladder. In this way a strong application of 10, 20, or 40 per cent. can be made, the end of the speculum then being applied to the area immediately adjacent and a similar treatment given. By continuing to apply the end of the speculum to the contiguous parts of the affected area an extensive surface can be covered with the treatments without involving the rest of the bladder.

8. Curettage.—Curettage of the diseased bladder is sometimes serviceable. A few years ago we made frequent use of the sharp curette in removing diseased surfaces, endeavoring to stimulate the tissues to throw off the infection. We believe that a fenestrated sharp curette is occasionally useful in treating small areas of inflammation. The spot to be curetted should be carefully located through a larger cystoscope, No. 12, and then the curette should be used under the direct control of the eye. The ureteral orifices must be spared, as an injury

at this point favors an ascending infection (J. Sampson). Another way of curetting the bladder is to wipe it out thoroughly with gauze. After a suprapubic or a vaginal incision has been made it can be wiped out with a piece of gauze stretched over the finger and used to rub off the surfaces as though one were attempting to scrub out the infection. Such a treatment is a good preliminary to the faithful use of irrigations to keep the bladder clean and free from any accumulating débris. We have tried packing the bladder with a long strip of narrow gauze, medicated or plain, left hanging out of the urethra as a drain, to act as a cleansing medium. We believe this procedure may have a small field of usefulness in the future.

9. Drainage of the Bladder by the Urethra.—In some cases the bladder may be continuously drained by means of a small mushroom catheter introduced through the urethra. This may be left in for a week or longer, by its continuous drainage preventing distention of the bladder, and keeping the organ at rest; few patients, however, will tolerate the presence of the catheter in the urethra for days together. The catheters so introduced should be kept clean by irrigating the bladder thoroughly at least once or twice every day. One of us (Burnam) has used constant irrigation in this way with good results, keeping two small catheters cemented side by side in the urethra.

10. Drainage by a Vesico-vaginal Incision.—One of the most valuable methods of treatment at our disposal is drainage through the vesico-vaginal septum, effected by cutting through the anterior vaginal wall and establishing a fistula there. This is the classic procedure for bad cases, much used by the distinguished T. A. Emmett. The cases in which it is proper to use this form of treatment must be carefully distinguished, as it is distressing to a patient to live for several weeks or months with constant escape of urine and with the expectation of an operation for a fistula at the end of the period. It is best adapted to those cases which are of long standing, painful, and utterly intolerant of any distentions or any local forms of treatment. As a rule, with extreme patience even the worst and most intolerant cases of cystitis can be distended by devoting weeks to securing the first substantial improvement. It is in just this class of case, however, that the drainage plan of treatment does its best work, by cutting off this period of delay and saving several months in the recovery. The effect of the drainage is to put the bladder completely at rest and to keep it clean. To do this the opening should be large enough for the urine to escape freely; the vaginal opening must also be sufficiently large to prevent any retention of urine in the vagina. In some of the bad cases of ulcerated cystitis, after making a thorough preliminary examination under anesthesia, it is well to proceed at once to make the vesico-vaginal opening.

This is done in the dorsal position by distending the bladder with water, introducing a pair of curved artery forceps through the urethra, and pushing down the anterior vaginal wall just beyond the internal urethral orifice, while the posterior wall is retracted by a Sims speculum. (E. C. Dudley, "The Principles and Practice of Gynecology," 1904, 331.) The incision is now made backward in the median line, either with a sharp, pointed scissors, or a knife, cutting through all the layers between the bladder and the vagina. This opening should be about $\frac{3}{4}$ inch in length. If the patient has been examined in the knee-breast posture and the bladder is full of air, a quick way of making the opening in the bladder is to plunge a curved knife through the septum, while retracting the posterior vaginal wall by a speculum. An ample opening can be made in this way in less time than it takes to describe it (Fig. 557).

The next step is to suture the mucous membrane of the bladder to the vaginal mucosa to prevent too rapid closure. If the opening is easily accessible the two mucosæ may be united with a continuous fine catgut suture (Fig. 558). As a rule, however, the surgeon will find that it is easier to unite them with from 4 to 6 interrupted sutures. In a nullipara it will be necessary to break down the vaginal opening by incising the perineum posteriorly, and then drawing out and sewing the vaginal mucosa to the skin, so as to leave a good opening for the immediate escape of urine. Unless this is done, a tight vaginal orifice is left, and, when the patient lies down, the urine accumulates in the vagina, backs up into the bladder, and causes all the distress it did before the bladder was opened. A patient with a fistula of this kind ought not to expect to have it closed in less than 6 weeks to

FIG. 557.—OPERATIVE FORMATION OF VESICO-VAGINAL FISTULA. A clamp is introduced through the urethra and slightly opened. This serves as a guide in making a mid-line incision with the knife, as shown. The opening should bisect the trigonum, but not cut the sphincter of the neck of bladder. It should, however, be sufficiently long to prevent premature closure. (Mrs. A., 1910.)

6 months. Then if, on examination, the bladder walls are found entirely healed, the opening may be closed by splitting the mucosæ and sewing the tissues together without loss of substance (see operations for vesico-vaginal fistula). Lingering infections must be treated by irrigations or distentions. Sometimes one succeeds by draining, which clears up the disease down to its residual point; that is to say, there may remain after drainage, as after distention treatments, an obstinate area of inflammation which refuses to get well, a sort of irreducible minimum inflammation. This the operator proceeds to treat more aggressively by excision (*q.v.*).

A patient with a fistula needs constant care and supervision, and does better if she can remain in the hospital. A protracted case, however, usually prefers to go home and trust to time and the continuous drainage to relieve the inflammation, returning after a stated interval to the hospital for inspection and closure of the opening.

FIG. 558.—COMPLETION OF OPERATION SHOWN IN LAST FIGURE. The suturing of the vesical to the vaginal mucous membrane is easily carried out with catgut sutures and insures against spontaneous closure, which otherwise occurs.

11. Tub Treatment.—In several instances of extremely obstinate cystitis we have succeeded in securing entire relief and recovery by keeping the patient in a warm water bath, after G. L. Hunner's plan (*J. Am. Med. Ass.*, 1907,

xlix, 2066), the purpose of which is to keep up a continual drainage and cleansing of the wound. To make this effective there must be a vesico-vaginal or a suprapubic opening, or both, and the vaginal orifice must be sufficiently dilated to allow the water free entrance and exit. Sometimes a catheter introduced into the urethra or through a suprapubic opening serves well to keep up a continuous flow when connected with a reservoir above (Fig. 559). The patient is immersed in the bath as far as the lower abdomen, and as she lies comfortably in the warm water she is able to amuse herself with reading, sewing, or other occupations. The water enters and runs out of the tub continuously, and is kept at a temperature of about 100° F. by means of a thermostat, which regulates the gas so that there is a continual delivery of warm water from the cold water spigot, if need be, into the warm tub. The patient is kept in the tub as long as she can stand it with comfort. Most patients do not tolerate the treatment well at first, and can only remain in the water for from half an hour

to an hour once or twice a day. Later a patient stays in with entire comfort for three or four hours or even longer. Treatment can be kept up for several weeks and stopped when the disease has almost disappeared. Remember that a happy alternative to these tub treatments is the introduction, through the urethra, of 2 small catheters cemented together and held in place by a piece

FIG. 559.—HUNNER'S PLAN OF CONTINUOUS IRRIGATION OF BLADDER WITH PATIENT IN A TUB. The catheter enters the bladder through the urethra and the outflow takes place through an artificial vesico-vaginal fistula. The photograph is one of a celebrated case in the annals of the hospital as the patient had had her distressing disease for many years and suffered many things of many physicians in vain.

of rubber sheeting forming a perineal pad. In this way the irrigations can be kept up night and day. By raising the irrigating bottle the degree of distention of the bladder is regulated and can be varied from time to time. The use of a bed pan, as shown in Figure 560, may also be found of great value.

I give here a few typical cases with the results:

Mrs. J. A. W., age 37, admitted to hospital March 8, 1910. The complaint was pain and frequency of voiding, which steadily grew worse, the patient being forced to void from 6 to 8 times at night and from 15 to 20 times

during the day. The trouble came on without any warning whatsoever. The patient had been married for 8 years and had no children. On examination the urine was found to contain pus, some albumin, a few red blood cells, and colon bacilli in abundance. The bladder showed the entire left half deeply

inflamed and infected. The bladder measurements were: 5 cm. posterior wall, 3 cm. vertex, 3.5 cm. left cornu, 6 cm. right cornu; its capacity was only 60 c. c. The patient had a series of treatments consisting of daily irrigations and distentions with $\frac{1}{2}$ carbolic acid solution and applications of silver nitrate, 1 to 1,400, starting on March 12th and ending on May 14th, which entirely cleared up the inflammation, and the bladder developed a capacity of 440 c. c. in comparison to the capacity, on entrance, of only 60 c. c. The kidneys in this case were carefully examined and found to be quite normal.

FIG. 560.—CONTINUOUS IRRIGATION OF THE BLADDER WITH PATIENT IN BED ON BED-PAN.

Miss E. A., age 20, admitted April 8, 1910. This patient suffered with tuberculosis of the right kidney and of the bladder. Her trouble began 2 years previously with frequency of urination, until she had to void every 15 minutes, day and night. This had grown worse by nervousness and the bladder irrigations which she had been having. On examination the urine was found to contain an abundant amount of pus and tubercle bacilli. Cystoscopic examination showed the main trouble around the ureteral orifice. There was also extensive disease of the right side of the bladder, the left side working with comparative ease. As the catheterization of the ureter showed that the right side was tuberculous and the left side normal, right nephrectomy was carried out on April 22, 1910.

When the patient came in the bladder measurements were: posterior wall 2.5 cm.; vertex, 2 cm.; left cornu, 3 cm.; right cornu, 2.5 cm.

After removal of the kidney and ureter by operation, and distentions of

the bladder which increased its capacity from 60 to 300 c. c., cystoscopic examination showed that the bladder and urine had become perfectly normal.

12. Excision of the Diseased Area.—One of the most valuable and convenient of all forms of treatment at our disposal is that of excision of the diseased area. It is never a method of first resort. When, however, treatment by irrigation, distention, and drainage, in spite of the fact that the disease has cleared up in almost all parts of the bladder, leaves a residual area of

FIG. 561.—LARGE SOLITARY ULCER OF BLADDER, AS SEEN THROUGH SUPRAPUBIC OPENING.
(A., Aug. 10, 1900.)

ulceration or granulation, particularly when there is a tendency toward hemorrhage, then this aggressive piece of surgery may be used as a last resort. It often gives prompt and radical relief. Preliminary to excision the diseased area should have been carefully studied, measured, and mapped out (Fig. 548).

The method of performing an excision is to insert a mushroom catheter into the bladder and after washing it out well, to leave it there. Then put the patient in the Trendelenburg position, making a transverse suprapubic incision about an inch above the symphysis pubis, taking care at every step not to open the peritoneum. As soon as the deep fascia is divided and detached from the recti in a direction up as well as down, the lax muscles are widely retracted,

Next take a Politzer bag or a Davidson's syringe and force air into the bladder until it is felt rising up like a hard lump behind the symphysis, being careful not to burst it. The top of the tense bladder is easily handled and freed from the investing fat. Throughout the whole procedure of opening the bladder do not detach the investing loose fascia, but mark it and, if necessary, put a stitch through it so that it can be picked up readily at the closure of the wound.

FIG. 562.—SUPRAPUBIC EXCISION OF ULCER OF BLADDER. The bladder is opened through a mid-line incision and the ulcer on the upper posterior wall is exposed. The dotted line maps the part of the bladder to be excised. (A., Feb. 21, 1910.)

As soon as the vertex comes into view, it is caught on either side with a silk traction suture, and then incised in the median line. Through this opening, with a head mirror and a cylindrical metal speculum (Kelly's), the bladder is examined in all its parts, determining exactly the location and extent of the disease. If the excision is to extend from the vertex down toward the base, the median vesical incision is best, but if the area to be excised lies wholly below the plane of the incision, then it is better to open the bladder transversely to get a freer access to the interior. An affected area near the vertex or on the posterior wall is now excised, using blunt scissors and carrying the dissection through the mucosa and muscularis in the sound tissues around the diseased area. Any actively bleeding vessels must be caught with pointed

forceps and tied with fine catgut. More superficial areas of inflammation can sometimes be removed by cutting through the peritoneum at any point. After excising the diseased area, the defect in the bladder walls should be closed by a continuous suture of fine catgut passed wholly on the mucous surface. A con-

FIG. 563.—SECOND STEP IN OPERATION SHOWN IN LAST FIGURE. The drawing to the right shows dissection of the peritoneum from part of the bladder, the seat of ulcer. The diagram to the left shows the direction and extent of separation, as indicated by arrows.

tinuous interlocking fine silk suture may then be used on the outside of the bladder to reinforce the inside sewing, while an additional fine silk or fine linen suture draws the investing fibrous fascia over the bladder wound and protects it completely. The fascia is then united from side to side, and, finally, the skin, closing the abdominal wound in all but its median part, where a small drain is inserted and left for three or four days. A mushroom catheter is then left in the bladder, through the urethra, and the bladder kept empty and gently washed out twice daily for a week. The entire procedure is well shown in Figures 561-565.

If the disease is more extensive, as in tuberculosis, and it is necessary, in order to attack it effectually, to get a better exposure and to cut through the peritoneum, we do not hesitate to do this, making a free incision and packing off the rest of the peritoneal cavity on all sides so as to isolate the pelvic peritoneum.

In a woman the uterus can be caught and lifted up and the bladder detached from the cervix when the disease extends below this point. A wedge of the bladder, including its peritoneal covering, is then freely excised, and the organ closed up with one or two layers of sutures uniting the peritoneal surfaces over the wound.

FIG. 564.—THIRD STEP IN EXCISION OF ULCER FROM BLADDER. The ulcer is excised and the bladder is being sewn together with figure-of-eight fine catgut sutures, as shown.

Sequestration.—The round ligaments and the uterus can then be sutured to the abdominal wall from side to side above the pelvic brim in order to sequestrate completely this portion of the peritoneal cavity and thus eliminate all danger of infection (Figs. 566-568). The little artificial peritoneal pouch shut off in this way can be drained freely through the lower angle of the incision. In a case of hemorrhagic cystitis in which we did this we had occasion to open the abdomen several years later for another cause and found no trace of the sequestration operation; the adhesions had been absorbed and the parts had gone back to their normal condition.

The amount of tissue excised from the bladder may vary from a wedge not more than 3 or 4 cm. in length, by 2 or 3 cm. in width, to one-third or even one-half the size of the bladder. The larger excisions are especially made in tuberculous cases where kidney, ureter, and bladder are seriously diseased.

FIG. 565.—THE LAST STEP IN EXCISION OF ULCER OF BLADDER. The bladder is closed down to the last stitch, which is not yet tied. The perivesical fibrous tissue, which we have throughout avoided stripping off or injuring, is now brought together with a continuous half-hitching stitch, as shown. This covers the sutures in the bladder and adds greatly to the security of the closure.

Cicatrices in the Bladder.—Those who recover from a severe cystitis often find that the capacity of the bladder is greatly lessened, and may imagine that the necessity for urinating frequently shows that the inflammatory disease still persists. Examination reveals a bladder divided into one or more loculi by prominent, sharp, falciform, non-vascular ridges. Here lies the difficulty, and the question is what can we do to relieve it. Ordinary irrigation and distention treatments are of no avail, but we have several times successfully carried out the following plan: We first measure and establish carefully the capacity of the bladder. We will say it holds 100 to 150 c. c. We put the patient under profound anesthesia and fill the bladder; then slowly, with a piston syringe, force in

FIG. 566.—SEQUESTRATION OF BLADDER TO INSURE AGAINST PERITONITIS AFTER A SUPRAPUBIC OPERATION. The diagram shows a sagittal view of the body. Note the detachment of the peritoneum, which is sutured to the top of the fundus uteri and to the round ligaments. Note also the line of sutures in the bladder wall.

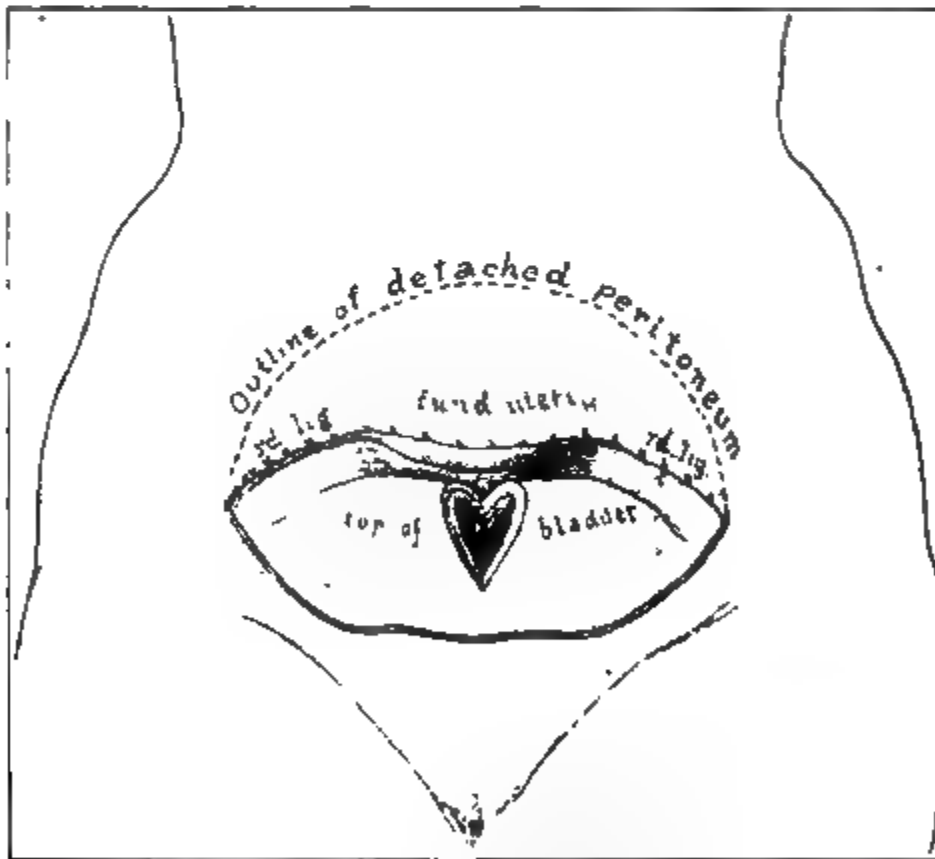


FIG. 567.—SEQUESTRATION OF BLADDER, AS SEEN FROM FRONT. The degree of detachment of the peritoneum from the anterior abdominal wall will depend upon the length of the incision made in the bladder.

about 100 c. c. more; there may be a little bleeding afterwards. The patient is kept quiet for a few days until this is over; she returns after 3 or 4 weeks for another distention treatment up to 300 or 380 c. c. The effect of this is to rupture the septa slightly, leaving a superficial healing area. Where the sep-

tum is sharp and stands out prominently, one may put the patient in the knee-breast position and through the open cystoscope cut it carefully at several points with fine alligator bladder scissors (Fig. 569). Both of these procedures, that of overdistention and the incision of the septum, need to be carefully performed. If carelessly done there will undoubtedly be some cases of rupture of the bladder followed by peritonitis or urinary infiltration. Where this treatment has not been successful or the tendency to bleed is

FIG. 568.—SEQUESTRATION OF BLADDER IN MALE BY SUTURING OMENTUM TO ITS POSTERIOR SURFACE. A drain is introduced through the abdominal incision into the new-formed retrovesical space. The conditions pictured are those after completion of an operation.

marked, we prefer opening the bladder suprapubically and completely excising the scar area.

Summary.—To sum up what has been said previously regarding the treatment of cystitis, it is a matter of first importance that the physician should seek every opportunity to familiarize himself with the disease. Only with a familiarity gained by constant observation and careful attention to results of different methods of treatment can he undertake any given case with precision and assurance as to the final outcome. Only, too, with a familiarity gained by experience will he be enabled to decide just what forms of treatment are most likely to prove effective in a given case, and to avoid the wretched dilatory process of adhering indefinitely to one plan of treatment. We would emphasize again the fact that the treatment in almost every case is of a progressive character and that, if a milder form of treatment does not promptly yield good results, the next most aggressive form should be tried. In the worst cases it is

sometimes the best policy to proceed at once to make a fistulous opening to rest the shattered nerves and the inflamed bladder. Again, when the disease has been brought to what we call the irreducible minimum, that is to say to an infiltrated, ulcerated, bleeding area which, like an old devitalized scar, simply can-

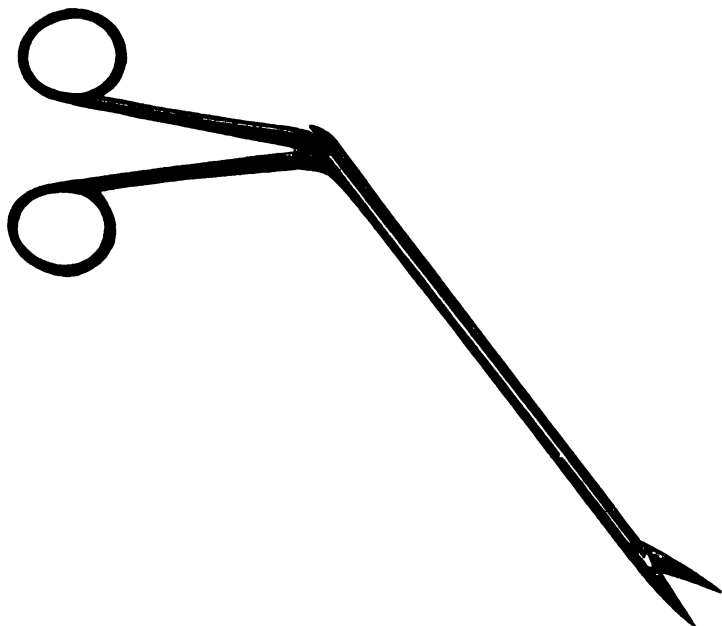


FIG. 569.—ALLIGATOR SCISSORS. These scissors work on the same principle as the alligator forceps and are very useful when it is necessary to use scissors inside the bladder through an open-air speculum introduced into urethra. ($\frac{1}{2}$ natural size.)

not form an epithelial covering, then time is wasted in attempting to do anything short of an excision. In the hemorrhagic cases we proceed more promptly to the excision treatment than in others.

CONTRACTED BLADDER.

A contracted bladder is one which remains permanently contracted and refuses to hold any more than a few c. c. of urine. In extreme cases the urine may dribble away continuously as fast as it flows in through the ureters. In others, as soon as a few teaspoonsful of urine have accumulated, the patient has to void and expel its contents. The term "contracted bladder," as thus defined,

is symptomatic rather than anatomical, and is commonly used to designate an organ which refuses to exercise its function as a reservoir for the accumulation and discharge of urine at normal intervals, and which is incapable of so acting. A variety of affections with this common symptom are wrongly grouped under this caption.

A true contracted bladder is an affection, fortunately rare, in which the walls of the bladder are extensively infiltrated, or in which the muscular coats have been more or less completely destroyed by chronic inflammation. The old tuberculous infiltrated bladders are to be regarded as the end-products of a vesical tuberculosis which has already run a protracted course in one of the kidneys. We restrict the name "contracted bladder" to this final stage of a chronically inflamed bladder, with the destruction of its muscular coats. We think we are safe in saying that 19 out of every 20 patients sent to the specialist and labeled "contracted bladder" are simply old cases of inflamed bladders intolerant of any urine, but still capable, under faithful treatment, of being distended to hold several hundred c. c. In 20 years we have had many cases referred to us as contracted bladder, some of them urinating constantly and almost spending their lives over a urinal or wearing absorbent pads, expelling little quantities of bloody, foul urine, but not one of them except the tuberculous cases has proved to be a true contracted bladder.

If the muscular coats have been destroyed by inflammation, the injury is irreparable, and the last result is an ascending renal infection. In making a diagnosis of a contracted bladder one must give due regard to the history of a protracted, severe cystitis, and then, putting the patient under an anesthetic, examine the bladder carefully bimanually, when the contracted organ appears as an ovoid, hard tumor lodged behind the symphysis. If the attempt is made to force fluid into the bladder under gentle pressure to estimate its capacity, it will be found capable of holding only a few c. c., but it should be borne in mind that in an ordinary severe cystitis it takes a profound anesthesia to do away with the vesical reflex spasmodic resistance.

Treatment.—In all grades of cystic inflammation approaching the extreme forms, say down to a cubic capacity of 50 or even as low as 30 c. c., there is a hope of effecting a cure by drainage of the organ through its base, giving entire rest, followed by subsequent distentions. The difficult phase of the treatment is often the earliest step of inducing a toleration of the first 30 or 50 c. c. After this initial step is taken, often with infinite patience, the distention sometimes runs up rapidly until 200 or 300 c. c. flow in, when it may once again become difficult.

In the extreme form of contracted bladder, where the anatomical elements

have been destroyed, there can be but one hope, namely that of enlarging its capacity at the expense of some other organ.

W. Kausch (*Arch. f. klin. Chir.*, 1907, lxxxiii, 77) describes a case of a true contracted bladder in a young man suffering from a constant dribbling of the urine, which was treated by detaching a loop of the ileum and re-anastomosing the bowel, at the same time sewing up the ends of the detached loop and bringing it down in close relation with the dorsum of the bladder, with which it was ultimately connected by a series of operations. By this means the capacity of the bladder was enlarged to 200 c. c., and the patient was able to hold the urine from one to two hours. He died 6 months after the operation, it was thought of tuberculosis.

ULCER OF THE BLADDER.

Ulcer of the bladder is a not infrequent complication of chronic cystitis, and is present in most tuberculous bladders. Independent of infection, there is a most interesting type of ulcer first noted by Lawson Tait in 1870, and given definite importance by Le Fur in "*Des ulcérations vésicales et en particulier de l'ulcère simple de la vessie*," Paris, 1901, a volume of over 800 pages. From time to time since Le Fur's report others, mostly case reports, have followed. Leo Buerger (*J. Am. Med. Ass.*, 1913, lx, 419) records two interesting cases. Under Tuberculosis and Cystitis the question of the infectious ulcers has already been fully considered. Here we will confine ourselves solely to the other form. Le Fur divides this class of ulcers into three sub-classes: first simple ulcer, situated near the neck of the bladder or on the trigonum, which is usually single, with its edges rounded, its base indurated, and the vessels dilated about it, in size varying from a pea to several cm. Second, acute perforating ulcer, seated in the vertex and particularly in the posterior wall; about these ulcers, which are usually punched out, the blood vessels are injected and there are frequently ecchymoses. Third, trophic ulcers, due to lesions of the central nervous system, or to injuries during operations about the bladder; these ulcers look like the others. The etiology is complex; in some cases it is clearly trophic. In most cases infection, which disappears, has been the cause. Le Fur has demonstrated experimentally that injuries, such as tying the urethra and adding infection, are potent causative factors.

In simple ulcer the solitary symptom is hematuria, intermittent in character. It closely simulates the hemorrhage due to neoplasm of the bladder. In the perforating ulcer infection and peritonitis are added to the hematuria.

The diagnosis rests upon a thorough and careful cystoscopic examination. The treatment for simple ulcer is topical application through the cystoscope. Buerger has noted marked improvement by light fulguration. When these measures fail the ulcer should be excised through a suprapubic opening, the technique of which is fully given on page 471. In perforating ulcer the suprapubic operation is indicated from the very beginning.

CYSTITIS IN CHILDREN.

Cystitis in infancy and childhood is not infrequent. It is commoner in the female than in the male, and is often associated with pyelitis. It may arise during any of the acute infectious diseases, and is especially common in diseases of the intestinal tract, to such an extent that regulation of the bowels is a more important therapeutic measure than the usual local measures for the urinary tract. Dr. George Waugh, of the Great Ormond Street Hospital of London, has observed the permanent cure of several cases of bacteriuria, which have resisted all treatment by appendectomy, relieving a chronic constipation. As a rule, frequency of voiding, with pain, fretfulness and crying at every emptying of the bladder should attract attention to the condition. In the severer cases there is often fever.

The principal literature has already been outlined in Chapter XXIII on Pyelitis. The treatment is also fully discussed there.

EXFOLIATIVE CYSTITIS.

An exfoliative cystitis is a peculiar inflammatory disease in which the mucous membrane of the bladder becomes necrotic and is thrown off entire or in shreds and expelled by the urethra. It is oftenest seen associated with a retroflexed pregnant uterus in the fourth or fifth month, or with a large tumor choking the pelvis and pressing upon the neck of the bladder and producing overdistention and ischemia. The membrane has been erroneously called diphtheritic and croupous. The tissue thrown off is the necrotic lining of the bladder, including its mucosa and submucosa, with more or less superficial layers of muscle, rarely extending into the deeper muscularis or to the peritoneum.

Boldt (*Am. J. Obst.*, 1888, xxi, 350) gives the appropriate name of *cystitis suppurativa exfoliata* to this disease. We owe the first careful examination of the membrane to the anatomist Luschka.

The outcome of such a desquamation is either a slow, complete recovery, or a recovery with incontinence and a contracted bladder. Death takes place from sepsis and double pyelitis. Patients die when the temperature rises above 105° F. (Boldt). Regeneration of the mucosa must take place from glandular spaces left behind and from the ureteral and internal urethral orifices.

Important articles on this subject are by: Boldt (*Am. J. Obst.*, 1888, xxi, 350); Krukenberg (*Arch. f. Gyn.*, 1882, xix, 261); Stoeckel (*Monatsber. f. Urol.*, 1902, vii, 201).

Symptoms.—The first symptom of exfoliative cystitis is retention of urine followed by dribbling. Hemorrhage may be marked, and vesical over-distention and colicky pains are prominent features. A vaginal examination may show that the tissues are edematous. The pulse creeps up and there is an anxious, pinched expression of the face, as the patient lies in a dorsal position with the legs drawn up. Later the foul, ammoniacal urine is loaded with pus and shreds of connective tissue, and epithelium and urinary salts passed under marked straining. The most characteristic appearance is the protrusion of shreds of membrane or even of a complete membranous sac, which looks like a bladder in process of complete inversion. This extraordinary sight is rendered the more remarkable when the sac is heavily coated with the salts of the urine. Under violent straining this bag may be discharged from the urethra.

Etiology.—While pregnancy in the fourth or fifth months and the pressure of a tumor are the common causes, exfoliation has been noted even in the second month of pregnancy. It may follow a surgical operation, such as extirpation of a cancerous uterus by the vagina (Thaler, *Cntrlbl. f. Gyn.*, 1911, xxxv, 550). Again, it may follow an abdominal surgical operation, such as the removal of subserous myoma (Loehlein, *Ztschr. f. Geburtsh. u. Gyn.*, 1888, xiv, 584). It has also been seen after injecting a caustic or a strong chemical solution, such as a hot salt solution, into the bladder (J. Mock, *Ann. d. mal. d. org. génito-urin.*, 1911, xxix, 1633).

J. C. Warren (*Boston Med. and Surg. J.*, 1896, cxxxiv, 641) reports a case from the practice of W. L. Richardson. The patient, who was not pregnant, was treated for a vaginismus by dilating the introitus. During convalescence she had a vesical irritation, which grew worse until a mass was seen protruding from the urethra about the size of the last two joints of the little finger. This was extracted in one continuous sheet. The patient suffered from incontinence and wore a rubber urinal; later she had to urinate every two or two and a half hours. An examination showed considerable residual urine in the bladder. She slowly improved and, after 2 years, seemed normal.

Hurry Fenwick exhibited a specimen of the mucous membrane of the blad-

der of a man removed through a perineal section done for the relief of a long-standing purulent cystitis.

As Warren states, an intense bacterial inflammation of the bladder mucosa may cause exfoliation.

Haultain (cited by Fenwick, *Lancet*, 1894, i, 209) collected 33 cases associated with pregnancy, 20 of which were due to septic infection, etc.

Diagnosis.—At first the symptoms may be those of ordinary cystitis. Examination shows the retroflexed pregnant uterus choking the pelvis. If then there is a cystitis and blood is passed, there is imminent danger of exfoliation. When a membrane covered with urinary salts begins to protrude from the urethra in a case of pelvic obstruction, the diagnosis is obvious. The membrane, whole or in shreds, is the distinguishing feature.

Treatment.—The treatment first and foremost must be prophylactic. Any retroflexed gravid uterus or tumor choking the pelvis must be watched with anxious solicitude. Any interference with the bladder function is an unmistakable warning to begin putting up the prophylactic fences by taking steps looking toward the relief of the pressure as speedily as possible. Relief may sometimes be given even when the necrotic process is already under way, as shown by an instructive case treated by F. Ahlfeld (*Cntrlbl. f. Gyn.*, 1898, xxii, 1017), whose patient recovered and went to term. The details in brief were these: The obstructed bladder reached the navel and contained purulent, turbid urine, with shreds of its lining membrane. Ahlfeld pushed the uterus up a little and inserted a large Meyer's ring pessary into the vagina; at the same time the bladder was treated with repeated cleansing irrigations. A little later the patient was put in the knee-elbow posture to assist in the reposition. Under this simple, sensible treatment the bladder improved, the uterus righted itself, and the pregnancy went to term. The lesson to be learned from this is that although we cannot often expect such a fortunate outcome, we should at least make the effort to attain it in a case not too far advanced. If the uterus cannot readily be brought into position with the resultant relief of the pressure, then it must be evacuated by dilating the cervix and packing it with iodoform gauze until the ovum is cast off. Extreme care must be taken not to introduce any of the discharges from the bladder into the vagina.

When a tumor or a cyst chokes the pelvis, one may try to push it up into the abdomen, but unfortunately it is not likely to stay there. Here one will do well to consider an immediate operation to remove the pressure, if the patient's condition permits. If a necrosis starts in with an incarcerated pelvic tumor, we believe the best plan would be to take the tumor away by an abdominal operation and to drain the bladder by making a long incision in the median

line almost from cervix to urethra, without sewing the two mucosæ together. This latter plan of continuous drainage, to which irrigations can be added with so much advantage, is well worth trying in any case not associated with pregnancy.

In the case of an adherent retroflexed uterus the safer plan is to empty the uterus by the vagina and to treat the bladder. If seen early, an abdominal operation freeing the uterus and bringing it into anteposition may solve the problem happily.

The treatment of the local condition of the bladder must be directed (1) to obviate any obstruction of the urethra by membranes in process of separation, preventing retention of the urine; (2) to rid the bladder of the rapidly accumulating débris of membranes, pus, and blood, and to heal it.

If the protruding membrane is made up of the mucosa incrustated with salts, it may be carefully drawn out a little and snipped off or perforated. The bladder should be irrigated two or three times a day, using a weak, warm permanganate solution, injecting at the end of the washing 50 c. c. of a solution of nitrate of silver, 1 to 1,000. A continuous irrigation is secured by a fine double catheter introduced through the urethra, passing through a small perineal pad of rubber, which serves to hold it in place. These cleansing local treatments are sedative in their action, but in severe cases one must use opium to prevent straining and the terrific expulsive efforts which can even rupture the weakened, parietic bladder wall.

SYPHILIS OF THE BLADDER.

Syphilis of the urinary organs is comparatively rare, rarer in the bladder than in the kidney. Nitze was able to say, in 1907, that so far, he had not recognized syphilis in the bladder. Casper repeats this assertion as to the living subject. M. Morris (*Indiana Med. J.*, 1897, xvi, 5) describes gumma of the bladder.

For further study consult P. Asch (*Ztschr. f. Urol.*, 1911, v, 504); Margulies (*Ann. d. mal. d. org. génito-urin.*, 1902, xx, 385), and Le Fur (*Ann. d. mal. d. org. génito-urin.*, 1902, xx, 1519).

Syphilitic disease of the bladder, when found, generally belongs to the tertiary period. The gummata are apt to have a small, papillomatous appearance, or again there is a frank, ulcerated condition of the vesical mucosa, which has nothing in its appearance to suggest its origin. The ulcer, seated at the base of the bladder, somewhere near one of the ureteral orifices of the trigonum,

presents an undermined, irregular margin coming out rather prominently from the interior of the bladder, surrounded by a red area, while the central part shows the detritus and grayish slough of an ulcer. In one case of evident cystitis the history of hemorrhage was prominent. Sometimes the disease manifests itself in a thickening of the bladder walls at its anterior portion, extending down the urethra, where there is a gummatous, edematous infiltration of urethra and bladder associated with dysuria and incontinence.

Diagnosis.—The diagnosis is best made by giving close attention, in any obscure and obstinate case of cystitis, to the history of syphilis, often insufficiently treated, which may have antedated the present affection by 10 or even 20 years. Syphilis should be considered where there is an obstinate catarrhal affection, demonstrably not tuberculous, which resists all the customary methods of treatment. No other affection of the bladder will clear up under anti-syphilitic treatment. In one case on record there was a gummatous tumor projecting into the bladder, which was mistaken for malignant disease, and an operation urged. The long duration of the complaint, however, tends to preclude this diagnosis. Doubt once raised, a positive Wassermann reaction will, of course, clear up the matter. A scraping of the lesion should be made and the spirochete looked for. In a case of G. von Engelmann (*Folia Urologica*, 1911, v, 472), a woman sixty years old had for half a year suffered from hemorrhages of the bladder. Cystoscopic examination showed, in the neighborhood of the right ureter, a tumor 3 cm. long, ulcerated, covered with pus, and incrustated, which the surgeon suspected was a carcinoma. However, on learning that she had had syphilis 20 years before, he ordered the mercurial cure, when the ulceration rapidly disappeared and the tumor left no trace behind.

Treatment.—The treatment of syphilis of the bladder is specific, by salvarsan, mercury, and the iodids; under this plan brilliant cures have been made, and without it nothing avails. Surgery is out of place here.

Asch dwells further upon the association of bladder symptoms with certain "parasymphilitic" affections, and points out, aside from the well-known paralyses of the bladder associated with tabes, that a trabecular bladder is itself one of the early symptoms of tabes which may appear before any other sign. He cites a case where the difficulties with urination and the trabeculæ appeared 10 years before the disappearance of patellar and pupillary reflexes. Later the bladder pains take the form of crises. Therefore, in the absence of any manifest cause for a trabecular bladder one must consider tabes. He cites a case under his care for occasional retention of urine where nothing could be found in the urinary organs to account for the retention except a slightly reddened

and swollen bladder mucosa. Careful examination showed a sluggish pupillary reaction and patellar reflex, but no other tabetic signs. Another patient simply had difficulty in urinating, with a little reddening of the mucosa; 2 years later a tabes rapidly ran its course. Again another patient complained of the terrific straining which he must make in order to urinate; this was so violent that defecation was associated with the act. There was nothing in the urinary passages to account for this. The pupils were somewhat sluggish and the patellar reflexes were weak, Romberg's phenomenon was only suggested, and the Wassermann reaction was weakly positive. These cases are not so hopeless as they seem to be at first sight, since a very active anti-luetic treatment and, above all, the intraspinal treatments with salvarsan have come to bring relief to these sufferers.

MALAKOPLAKIA.

This extremely interesting but rare condition of the bladder was first described and named by von Hanseemann (*Arch. f. path. Anat. u. Physiol.*, Virchow, 1903, clxxiii, 302). Most of the cases recorded have been found at autopsy, although the condition has been observed during life. It may be in association with colon-cystitis, or a tuberculous cystitis, or alone. The characteristic lesion is a small yellow plaque sharply defined from the bladder mucosa. These plaques vary in size from that of a pea to a quarter of a dollar, are invariably multiple, and frequently confluent. There is usually a pitting in the center, and in the larger plaques an ulceration. They extend into the submucosa. On microscopic section the plaque is found to be made up of large, flat cells with small eccentrically placed nuclei. These cells are packed closely together, with only a fine connective tissue stroma between them. In addition to these characteristic cells, there are colorless bodies which are very brittle and which vary in shape, most of them being roughly globular and on the average 5 or 6 microns in thickness. These lie either between the cells or in them, and are influenced by neither acids nor alkalis, as shown by stains containing iron. It is believed that they may be derived from the hemoglobin.

The histogenetic origin of these plaques is not known. Many authors have insisted that they are tuberculous. This seems questionable. No well-defined symptomatology has been worked out; the diagnosis in life should be made by cystoscopic examination and the removal of the tissue for microscopic examinations. One of the most recent and best considerations of this subject occurs in the article of Max Waldschmidt (*Ztschr. f. Urol.*, 1912, vi, 541).

CHAPTER XXXV.

INJURIES OF THE BLADDER AND URETHRA.

We will consider under this caption injuries to the bladder outside of labor or the use of obstetric forceps, symphysiotomy, pubiotomy, lithotomy, herniotomy, and other accidental surgical injuries. In other words, our caption covers only injuries which are due to violence or to accident. It is evident that injuries of this character naturally affect men for the most part, as they are more exposed to harm from travel, from dangerous occupation, from brawling when in liquor, etc.

Nitze and Sonnenburg, as well as Tuffier, reckon the proportion as 90 per cent. men to 10 per cent. women. Women are also less liable to injury because of the transverse position of the bladder in them, as well as because it lies on an elastic cushion protected by the uterus behind. Occasional cases of rupture in children are found scattered through surgical literature.

The successful treatment of these injuries is one of the greatest triumphs of modern surgery, for they were ever the despair of all the older physicians and surgeons, and the undisputed aphorism comes down to us from Greek antiquity that "no case of injury of the bladder ever recovers." It has remained for the last thirty years to bring this lesion within the reach of surgery and to transform defeat into victory by healing a large percentage of the cases. From the year 1878 on, surgical literature teems with references to this important subject.

One of the first writers to collect, study, and summarize a considerable group of cases was Stephen Smith, of New York, Assistant Surgeon to Bellevue Hospital (*N. Y. J. Med.*, 1851, vi, n. s., 338).

To the credit of American surgery, the first successful operation was done by Dr. A. G. Walter, of Pittsburgh, Pennsylvania, in the year 1859 (*Med. and Surg. Reporter*, 1861, vii, 153).

The patient was a blacksmith, 22 years old, who was kicked in the abdomen in a fight; following this he had strangury, with intense abdominal pain and inability to urinate. Dr. Walter says that, as he could get no backing from his consultants, he opened the abdomen on his own responsibility 10 hours after

the injury, making a median incision extending almost from umbilicus to pubis. The accumulated urine was carefully sponged out of the cavity, when a rent two inches in extent was found in the fundus of the bladder. "The cavity of the abdomen being cleansed of the noxious agent, the wound of the bladder was left to itself, as no urine was seen to escape from it." The abdomen was closed with silver wire sutures. The patient made a good recovery, with a retention catheter kept in between two and three weeks. Walter then urges this as the only proper plan of treatment, and further says: "To preserve a patient's life under these circumstances, it must be resorted to at once, as without it the efforts of nature and the resources of science are powerless."

The following articles may be read with advantage:

"Die Traumen der Harnblase" by Max Bartels (*Arch. f. klin. Chir.*, 1878, xxii, 519). Bartels was the first to go fully and exhaustively into the history of the subject in a monograph of 190 pages; his elaborate paper includes a study of 504 cases of injury of the bladder.

There is a brief but valuable paper with statistics, by James Kerr, in the *Annals of Surgery*, 1893, xviii, 647.

Samuel Alexander has a careful paper on intraperitoneal rupture of the bladder treated by laparotomy and suture (*Ann. Surg.*, 1901, xxxiv, 209).

Daniel Fiske Jones (*Ann. Surg.*, 1903, xxxvii, 215) writes on intraperitoneal rupture of the bladder.

Ashhurst (*Am. J. Med. Sci.*, 1906, n. s., cxxxii, 17) has a thorough-going study of the subject with full citation of all the important literature.

F. A. Besley (*Surg., Gyn. and Obst.*, 1907, iv, 514) goes carefully into the mechanism of the injury and cites a number of experiments, with diagrams.

E. J. Senn (*J. Am. Med. Ass.*, 1907, xlviii, 1021) notes that in 179 cases of ruptured bladder there were 109 cases of fractured pelvis.

Edward Quick (*Ann. Surg.*, 1907, xlv, 94) reports a case operated upon successfully 254 hours after accident.

Watson and Cunningham give rupture of the bladder careful consideration in their "Genito-Urinary Diseases," 1908, i, 447, and present valuable statistics.

I. E. Tikanadze (*Ztschr. f. Urol.*, 1909, iii, 841) has a paper on the question of surgical intervention in shot wounds of the bladder.

P. Wolfer contributes an important paper on the traumatic injury of the bladder from Krönlein's Clinic, Zurich, in the *Beiträge zur klinischen Chirurgie*, 1910, lxvi, 280.

Moritz Cohn (*Dtsch. Ztschr. f. Chir.*, 1911, cix, 509) writes upon in-

complete rupture of the bladder, and A. Galaktionow (*Dtsch. 'Ztschr. f. Chir.*, 1911, cx, 449) upon intraperitoneal rupture of the bladder.

ETIOLOGY.

The causes of a rupture are two: first, a full bladder; and, second, an injury in the region of the lower abdomen. The empty bladder is almost never injured unless it be from a stab wound or a gunshot wound. If the bladder is full, a rupture may then be brought about either by a blow upon the abdomen, a fall on the buttocks, or a crushing force applied to the pelvis.

Richard Douglas ("Surgical Diseases of the Abdomen," 1903, 659) states: "Since 1897, we are able to tabulate 9 cases of intraperitoneal rupture of the bladder out of 113 contusions of the abdomen, a relative frequency of 8 per cent. as compared with the total number of traumatisms."

Railroad injuries, falls from a wagon, being ridden over by a wagon, a fall from a height, a kick, a shot wound or stab wound of the bladder are common causes.

Bartels (*loc. cit.*) subdivides his 504 cases of vesical rupture as follows:

Stab wounds, 50.

Shot wounds, 285.

Simple lacerations, 169.

Also, of his 504 cases, 74 had an injury of the rectum, 196 had bone injuries.

It is a serious question whether a violent muscular contraction of the abdominal walls can rupture a full normal bladder; a few cases seem to show that such an accident can occur. A diseased bladder may be ruptured in this way.

Rare instances of rupture in women have been observed in the third and fourth months of pregnancy with retroversion; in one the rupture occurred from sneezing, without any gangrene of the mucosa or evident weakening of the vesical wall. As noticed by numerous writers, for more than half a century, drinkers are predisposed to rupture of the bladder, for all the predisposing factors are there. The bladder is constantly filled to overdistention, the sensibility of the patient to a normal desire to evacuate being benumbed, his abdominal muscles are relaxed and not on their guard, and he is quarrelsome—then there is a fight or a fall and a rupture.

Rivington states that, in 41 out of 108 cases of simple intraperitoneal rupture of the bladder, it is distinctly specified or else implied that the patient had

been drinking alcoholic liquors, or was actually drunk at the time of the accident.

Ashhurst dwells particularly on this factor, and further notes that, in cases in which the patient was intoxicated at the time of accident, the mortality was over 43 per cent., while among the sober it was less than 28 per cent.

CLASSIFICATION.

The character of injury thus produced varies from a small point of rupture on the peritoneal surface to a rupture extending fore and aft over the whole extent of the bladder.

The laceration is either extraperitoneal or intraperitoneal; it may also be subperitoneal, not involving all the coats of the bladder; this is called "incomplete rupture."

A further exceedingly important classification is that of ruptures with and without any external wound, the external wound naturally predisposing to infection.

Injuries of the bladder are also subdivided according as they are complicated by other injuries, such as fracture of the pelvis and rupture of the rectum (by impaling). Shot wounds constitute a special class, in that the bladder is liable to be injured in more than one place, and large vessels in the neighborhood may be injured coincidently. Gunshot wounds are naturally commoner in war times. It is evident, therefore, that statistics taken then will vary greatly from those taken in times of peace.

The frequency of the intraperitoneal to the frequency of the extraperitoneal ruptures is as 80 to 20. Bartels estimates 59 per cent., however, as intraperitoneal.

SEQUELÆ.

The results of rupture of the bladder are extravasation of urine and blood into the surrounding tissues, followed later by infection, suppuration, and septic absorption. In intraperitoneal rupture a mild irritative peritonitis may result, which, in a few days, becomes septic, and is followed by death. Death occurs from shock, from the coincident injury, from hemorrhage, from peritonitis, septicemia, or pneumonia. In the extraperitoneal cases the septicemia may arise from septic thrombi at the neck of the bladder. Peritonitis, one of the most serious sequelæ, arises from an infection transmitted from the bowel

or from a coincident injury of the bowel, or from infection extending in from the external wound, or, again, from a preëxisting cystitis.

DIAGNOSIS.

The cardinal diagnostic points are an injury, followed by desire to urinate, often with distressing inability to pass more than a little bloody urine but with unabated desire, and a swelling in the lower abdomen.

If the extravasation is intraperitoneal, there are the symptoms of a mild peritonitis, which, after a few days, grow worse, with increasing distention of the abdomen, elevation of the temperature and pulse, and evident accumulation of fluid in the abdomen. A catheter brings away only a few drops of bloody urine. Fever, until there is an infection, is slight or entirely absent. The diagnosis may be easy or difficult. It may be completely masked when there has been an injury, a fall, or a crushing accident with profound shock. The accumulation of urine in the abdomen reached as much as six quarts in Judd's case.

When there are other coincident severe injuries, the surgeon is most liable to attribute the anuria to the profound shock.

The cardinal points in the diagnosis, then, are, in résumé: strangury and "bloody anuria," with pain above the symphysis. In his case of intraperitoneal rupture Quick puts the diagnostic points as follows:

"The sudden development of ascites following trauma, the strangury, blood from urethra, and the practical anuria for eleven days made the diagnosis of intraperitoneal rupture of the urinary tract the most probable."

Up to the first 20 hours the symptoms are strangury and the inability to urinate. After that there is liable to be the added element of infection, accompanied by fever, and, in intraperitoneal rupture, tumor and peritoneal symptoms.

The urgent symptoms of the rupture, so evident in the first few hours, fade away in a few days, while those of peritonitis become more prominent. For this reason it is important to secure a careful history.

There is a natural desire on the part of the physician in attendance to explore the bladder at once with a catheter, in which case he may push the point of the catheter up against the abdominal wall, where it may be felt just under the skin, if it has passed through the rupture into the abdominal cavity. The rule in Zeidler's clinic is that the catheter is not essential to diagnosis, which must be made from the symptom-complex, and further that the catheter may

be used but once, and that just before the operation exposing the wound in the bladder. This avoids the risk of ingrafting an infectious peritonitis by the indulgence of the natural desire to try to relieve by the catheter. We believe that catheterization is not so dangerous if done with extreme care, but it ought not to be done often.

It is further improper to inject fluids or gas into the bladder to see whether it returns in full amount.

Occasionally, in a doubtful case, with an X-ray apparatus at hand, a diagnosis can be made by injecting about 100 c. c. of a one per cent. emulsion of silver iodid into the bladder and then taking a radiogram. The diffuse character of the picture, without the lines of delimitation of the normal bladder, will at once graphically demonstrate the existence of a rupture. If there is an external wound the radiogram will also show its location and extent.

Not infrequently a differential diagnosis must be made between a ruptured kidney and a ruptured bladder. In both conditions we find profound shock with anuria or the occasional passage of a little bloody urine, and it is not always possible to determine whether the kidney or the bladder is hurt. The surgeon has often found himself obliged to make an incision into the loin to expose the kidney down to the bladder before he could discover just where the mischief lay. Any mark of a bruise in one region or the other is, of course, a valuable guide in determining where to cut. In such a doubtful case one is justified in testing the ability of the bladder to hold and to return a pint of fluid injected by catheter just before operation. Here, too, the emulsion of silver iodid and the X-ray will be of service. The same emulsion can be used in the renal pelvis, injected through a renal catheter, but the difficulty is that the patient is apt to be so extremely ill he cannot be much handled. The X-ray picture of a crushed kidney will also fail to show the customary outline of the normal organ for which every good radiographer looks.

In all cases in which a patient who has had an injury complains of a tenesmus in the bladder and inability to urinate, and is nauseated and tympanitic, we must consider carefully the possibility of a rupture of the bladder. In incomplete rupture of the bladder there is a desire to urinate, sometimes with inability to do so, but the abdominal symptoms are lacking. The tenesmus disappears when the bladder is emptied of its bloody urine. If an incomplete rupture is neglected there is often a gradual infiltration of the vesical walls, lifting up the coverings of the bladder and ending in an infection which may even terminate in a peritonitis.

TREATMENT.

There is no condition in surgery for which the treatment has shown a more satisfactory improvement than rupture of the bladder, the universal rule of death having been reversed, so that the patient may have a far greater chance of living than dying if he is properly cared for, complications being absent. Ullman, for example, found that in 237 cases of rupture not operated upon, there were only 22 recoveries; of 143 of these in which the rupture was intraperitoneal, only 2 recovered, while in 94 of extraperitoneal rupture there were 20 recoveries. The prognosis, of course, becomes worse according to the character of the associated injuries, especially in cases of fracture of the pelvis. The mortality is lessened greatly by prompt operative interference, and almost doubled after the first 12 hours.

Sieur (*Arch. gén. de méd.*, 1894, i, 282) gives the following significant figures from a small group of 34 cases:

Operated upon.	No.	Cures.	Deaths.
In the first 12 hours.....	13	8	5
Between 12 and 24 hours.....	10	3	7
Two or three days after injury.....	11	3	8

Watson and Cunningham show that the mortality is 88.7 per cent. in cases treated expectantly, while it is 42.2 per cent. in cases treated by operation. Schlanger estimates a 50 per cent. mortality, and Alexander 45 per cent.

These figures discourage delay, but they are not calculated to make the surgeon despair in the late cases, for recovery from an intraperitoneal injury which has lasted for some days is possible. For example, Blumer had a case operated upon on the sixth day with recovery, and E. Quick (*Ann. Surg.*, 1907, xlv, 94) operated successfully 254 hours after the injury. He first catheterized and drew off 5,800 c. c. of bloody urine by the catheter, causing a disappearance of the abdominal distention, after which the operation was done and the patient recovered.

James R. Judd (*J. Am. Med. Asso.*, 1910, liv, 1207) operated after 77 hours, and let out about 6 quarts of urine from the abdominal cavity; the peritoneum was everywhere injected, but there were no other evidences of peritonitis. The torn edges of the bladder were freshened and sutured, the abdomen was closed, and the patient made a good recovery.

Walter, as quoted, was the first to succeed by opening the abdomen and evacuating the urine.

H. H. Grant, of Louisville, Ky. (*J. Am. Med. Asso.*, 1888, xi, 118), has the high honor of being the first surgeon to open the abdomen and suture the rent in the bladder successfully. Grant did this, with the concurrence and assistance of Dr. A. M. Carteledge, on a patient 19 years of age, who, 5 hours before, had been run over by a wagon, which passed across his pelvis. An incision was made up to the umbilicus and a half gallon of bloody urine removed; the rent in the fundus of the bladder was found to be $2\frac{1}{2}$ inches in a transverse direction. It was closed with 11 sutures of carbolized silk. A soft rubber drainage tube was then inserted behind the bladder, and the rest of the incision was closed. The patient was catheterized every 2 hours afterward and made an excellent recovery. The catheter is only a valuable adjunct and not a curative agent, whether used temporarily or permanently, nor ought one to use the catheter to make peritoneal lavages. (Thorpe.)

Puncture by the rectum or suprapubically is also a procedure to be rejected.

These methods, which would be extremely valuable in the absence of surgery, must never be allowed to take the place, as temporary procedures, of the exposure and direct treatment of the wound in the bladder.

Surgical treatment to-day is undoubtedly the one safe way of handling rupture of the bladder. The object of the surgeon is to obviate the two most serious risks, namely: (a) peritonitis in the intraperitoneal, and (b) urinary infiltration in the extraperitoneal cases. These ends are attained by a free suprapubic incision exposing the tear, by suture of the tear, and by drainage of the wound and of the bladder. The operation ought to be done as soon as the diagnosis is made, unless profound shock calls for a temporary delay.

In bad cases spinal anesthesia or a local anesthetic, such as novocain, will be better than ether or gas. In event of a general anesthetic the responsibility of the anesthetist is great. Relaxation is absolutely necessary, but the amount of the anesthetic must be limited to the absolute necessities of the case.

The abdomen must be thoroughly dried out in a position of moderate elevation. The best suture material is chromic catgut or fine silk. One may, like Albarran, sew up with a continuous catgut suture and then over this pass a continuous sero-serous suture of silk through all the layers of the bladder, including the mucosa. A continuous suture saves much time, but it must be snugly adjusted and each point of the suture passed about 3 mm. from the last one. If it is difficult to reach the posterior part of the wound, it may be drawn up into view by first sewing the part nearest to the operator, and then, ad-

vancing step by step, if interrupted sutures are used, pulling on them and so drawing the posterior part into view. (Jones.)

The patient is then let down from his elevated position and the abdominal wound closed with a drainage tube surrounded by gauze and inserted in the lower angle, where it can be left for two or three days. A self-retaining catheter is then passed by the urethra into the bladder, and the bladder kept drained also for several days. If the patient is in an extremely bad condition, the most the operator is able to do may be to open and drain the peritoneal cavity or to drain the prevesical space and insert a catheter into the bladder.

In intraperitoneal rupture, where the wound is more irregular, the operator may be obliged to content himself by sewing up as much of the rupture as he can and then draining the prevesical space, trusting to the drain, and to the urethral catheter draining the bladder, to put the parts at rest and facilitate the cure and the rapid closure of the opening. In some extraperitoneal ruptures the location of the swelling will clearly indicate a deep perineal incision and drainage or a suprapubic or an inguinal opening, or, better still, two of these incisions combined.

Hildebrandt (*Berl. klin. Wchnschr.*, 1907, xliv, 137), in intraperitoneal rupture, recommends extraperitonealizing the bladder by sewing the peritoneum of the abdominal wall back of the wound in the bladder, after the latter has been sutured. It is readily done when the rupture is at the vertex of the bladder. In women, if the tear is bad and the suturing uncertain, we would recommend extraperitonealizing the bladder by sewing the round ligaments and the fundus of the uterus to the abdominal wall from side to side, thus putting the bladder into a little peritoneal pouch detached from the rest of the abdomen. This separation will last a few weeks and will later disappear entirely.

P. Wolfer, in behalf of Krönlein's clinic (*Beitr. z. klin. Chir.*, 1910, lxvi, 280), tabulates 67 cases of stab or impaling injuries (*Stichverletzung*).

The sharp or blunt instrument may enter the pubic region above the symphysis, or pass up through the perineal region, or, rarely, it enters through the obturator foramen, or through the vagina, or the gluteal regions.

When the peritoneum is injured the earliest possible operation should be done to expose the wound, to close it, and to drain the peritoneal cavity. When the peritoneum is not involved, the surgeon then has to take care of the contused rupture as well as of the wound in the bladder. If the rectum is injured, this must be drained by inserting a large tube surrounded by gauze. In some cases it is sufficient to put a permanent catheter in the bladder to keep it empty, thus preventing the urine from being poured out through the wound and contaminating it. Where the injury to the bladder has been but slight, cases have been

treated successfully by catheterizing at short intervals. If the external wound is large, it may be sutured in part and the remainder drained.

In the large and important group of shot wounds in the bladder, Tikanadze, in v. Fedoroff's Clinic (*Dtsch. Ztschr. f. Urol.*, 1909, iii, 841), recommends operation at the earliest possible moment. A suprapubic extra-peritoneal incision is made. If necessary, the peritoneum is opened, and then, if the location of the wound in the bladder is not found readily, the bladder ought to be opened, the mucosa examined carefully, and the wound discovered from within, when the openings may also be sewed from within, using plain catgut sutures which will be absorbed in part and discharged in part. In such injuries we must always look for a second wound. Sometimes the ball is found within the bladder, where it may form the nucleus of a calculus.

C. H. Anderson (*J. Am. M. Ass.*, 1900, xxxiv, 1505) wishes to dwell upon the value of hot saline infusion in a badly shocked case, and gives a clear account of a gunshot wound caused by a bar-room row. The bullet, 38 caliber, entered the right buttock behind the femur and lodged in the bladder. The patient, seen 6 hours later, was in profound shock and unconscious, the breathing was superficial, and the extremities cold and flabby. The surgeon waited 20 hours for him to improve, in the meantime giving two injections of a quart of salt solution at a temperature of about 135° F. The writer was greatly impressed by the evident improvement which followed the several injections of saline solution into the rectum. A suprapubic cystotomy was done and the bullet found loose in the bottom of the bladder, which had a little hole in its posterior wall. The bladder was then drained by the urethra without suturing the hole, but the peritoneum was not opened. About 5 hours later the pulse could not be counted at the wrist, so the abdominal cavity was opened at once and a quantity of grayish, foul-smelling fluid evacuated. After abundant washings of the abdomen, it was closed, with a drainage tube reaching to the bottom of the cavity behind the bladder. The patient left the hospital well on the 29th day.

In incomplete rupture of the bladder, unless the symptoms are slight, we ought to operate, opening the bladder, and discovering and treating the injury directly. Under this head see an article by M. Cohn in *Dtsch. Ztschr. f. Chir.*, 1911, cix, 509. It is best not to wait for threatening symptoms, but to forestall the urinary infiltration and detachment of the mucosa with the subsequent infection, which has destroyed some cases treated expectantly. If, after exposing the bladder, no injury is seen on the external surface, then it may be opened and the mucosa carefully examined. If a rent is found in the mucosa, it may be sewed up from the inside, then the anterior wound

made for inspection should be closed, and the suprapubic incision also closed with a small drain. It is well, sometimes, to draw the peritoneal surfaces together with a row of sutures, further inverting the wound area and opposing a buttress to the invasion of infection. If the wound cannot be sewed up inside, we may then make a complete rupture of it, enlarging it as necessary, and sewing it up wholly from the abdominal side in two layers.

CHAPTER XXXVI.

DISEASES OF THE PREVESICAL SPACE.

Definition.—The prevesical or preperitoneal space, or, as it is sometimes called, the space of Retzius, is an anatomical area designed to accommodate the expanding and contracting bladder, and to allow it the utmost freedom of motion without interference by the abdominal pressure of the surrounding organs.

This space, first described by Retzius, the Swedish anatomist, is compared by him to the capsule of Tenon, in which the eyeball so freely plays.

The limits of this vesical pocket are:

In front, the posterior surfaces of the symphysis pubis, and of the lower portion of the recti muscles, extending above as far as the falciform semilunar line of Douglas; posteriorly, the peritoneum; laterally, the external border of the recti muscles; below, the perivesical cellular tissue continuous with that of the true pelvis, the *fascia propria* of the pelvis.

The relations of the prevesical space to the surface of the body are described by Bouilly in the following manner:

(1) A transverse line is drawn across the *linea alba* about 8 or 9 cm. below the umbilicus,

(2) Two vertical lines are drawn along the external border of the recti muscles extending from this transverse line down to the pubis. In this way a rectangular space is marked out, behind which the bladder enlarges as it ascends from the pelvic cavity in a state of moderate distention. This quadrangular area is a relatively weak space in the abdominal wall, which is here easily pushed forward by the distention of the bladder or by any other fluid collection behind the recti muscles.

Introductory.—A study of the anatomical facts just given shows that the bladder, no less than the uterus and the lower part of the rectum, is supplied with a special anatomical arrangement, consisting of loose cellular tissue, to provide for marked variations in its form. While the rectum is limited by its position in its bony pelvis, and only the lower part of the uterus is extensively surrounded by loose areolar tissue, the bladder, on the other hand, is much more richly supplied to provide for more frequent and extreme variations in size;

the analogy, therefore, of the bladder to the other pelvic organs is closer than has been suspected, and, indeed, the bladder may well be taken as the type of expansive organs in the body.

Two forms of disease in general are found involving the prevesical space, inflammatory affections and tumors of several kinds, as cysts, fibroid tumors, and exostoses.

Another important classification of these diseases separates those affections which start in the prevesical area from those which start elsewhere and only involve it secondarily; this classification is particularly important in considering the group of inflammatory affections where it is a matter of prime necessity to discover the original focus of the disease and to remove it, as well as its sequelæ.

There is nothing whatever peculiar about the prevesical area rendering it specially liable to any particular form of disease; its affections are among the rarest known to surgery. The diseases most frequently encountered here are inflammatory affections transmitted from the bladder, urinary infiltration and inflammation from ruptured bladder, and exostoses and inflammation from necrosis of the symphysis.

We have been much impressed, while scanning the literature of this subject, with the unsatisfactory nature of the case diagnoses. The mere presence of an abscess pointing above the symphysis is by no means sufficient to make the diagnosis certain. Intrapelvic tumors sometimes adhere to the lower abdominal wall and present many of the characteristics of an enlargement in front of the peritoneum; pelvic abscesses and the abscess associated with an appendicitis may also burrow and cause the formation of a phlegmon at this point.

History.—The history of prevesical affections is brief but interesting. Bernutz (*Archives gén. de méd.*, 1850, lxxxiii, 129) published a memoir in 1850 on "Phlegmons de la paroi antérieure de l'abdomen," in which he discusses the inflammatory affections of the prevesical space under the title "Phlegmon of the Fascia Propria."

Retzius published the first elaborate anatomical description of the area in 1856 at the Academy of Stockholm, and this work of Retzius was communicated by the distinguished anatomist Hyrtl, in 1858, to the Academy at Vienna. The most complete works which have appeared since that time are found in several French theses which have in great measure been inspired by the work of Guyon. Among the most important of these are those of Poisson, Gérardin, Bouilly, and Villiers.

Trecourt ("Mémoires et observations de chirurgie," Paris, 1769, Obser. 15, 152) furnishes us with the first published case, in a girl from 22 to 23 years

of age, who had an abscess as large as a turkey's egg above the symphysis, which he opened with a bistoury, two fingers' width to the right of the linea alba. On carrying the finger to the bottom of the abscess it entered a large cavity and passed easily to the left of the linea alba and beneath it. The wound closed slowly under treatment, and the patient recovered. The complete description leaves little to be desired from a clinical standpoint.

A case of de la Motte (*"Traité complet de chirurgie,"* édit. par M. Sabatier, i, Obs. 50, 205) serves well to show the difficulties of diagnosis. While this case has been cited in the literature of prevesical inflammations, we believe it was rather one of appendicitis with a localized peritonitis which that surgeon opened and drained with a good result.

Clinical History.—Inflammatory tumors of the prevesical space either originate in this area, when they may be called idiopathic, or they are sequelæ of disease elsewhere, and should be styled symptomatic. Bouilly, in a collection of 43 cases, found 27 idiopathic and 16 symptomatic; without doubt the closer sifting which this subject is destined to receive in the near future will more than reverse these figures.

In the first group of 27 cases of idiopathic affections the patients varied in age from 8 to 31 years, and there were but 4 females. One of these cases is cited by Boyer (*"Traité des maladies chirurgicales,"* etc., 1824, ix, 50); a woman, 26 years of age, fell 6 feet, in the second month of her pregnancy, and 6 weeks later felt the first violent pains in the lower abdomen. An abscess formed and opened in two places, at the umbilicus and just above the pubis. Both openings remained patulous, and the urine escaped by them, as well as by the urethra, until she passed through a natural confinement, when the fistulæ closed of themselves.

In the group of symptomatic inflammatory affections Bouilly finds that 9 out of 20 cases were in women. While in men the primary focus of the disease was almost always in the bladder, in women the original seat of the trouble was uterine or periuterine. He states that "in woman the inflammatory enlargement of the space of Retzius is oftentimes nothing else but the extension of a phlegmon of the broad ligament, or of the cellular tissue of the iliac fossa, developing under the same conditions, that is to say, after a confinement."

One of the most important causes of suppurative inflammation is found in the injuries to the symphysis sustained during labor, such as rupture of the joints, or symphysiotomy. A case of this kind came under our observation in the service of J. W. Williams, of the Obstetrical Department of the Johns Hopkins Hospital.

A case of suppurative inflammation of the symphysis pubis associated with the formation of a large abscess of the prevesical space is given by Dr. J. A. Gordon (*Boston Med. and Surg. Jour.*, 1876, xcv, 734). "The patient, twenty-four years of age, had symptoms during her third pregnancy indicating relaxation of the symphysis. Aching and sharp pains in the pelvis and thighs began on the fifth day after delivery, and increased in severity during several days following. Slight chills occurred on the ninth day, with increase of temperature. On the fifteenth day the temperature was 103° F.; there was prostration, nausea, and vomiting, with coated, dry tongue. The slightest motion induced extreme pain. Decubitus was dorsal only, with feet widely extended. Pressure near the pubic symphysis caused intense suffering. Catheterization was necessary twice daily. On the eighteenth day a severe chill occurred; the temperature reached 105½°, and the pulse 120. Constitutional symptoms abated the following day, and eleven days later (the thirtieth day after confinement) Dr. Gordon, by means of the pneumatic aspirator, evacuated ten ounces of pus from the mons veneris. The fluctuating tumor at this point, previous to the removal of the pus, was of the size and shape of half a cocoanut. There was a free, bright-red discharge from the vagina. A fluctuating tumor pressed the uterus backward and occupied the front of the pelvic cavity, displacing the urethra and extending downward into the left labium. Three days later, about the same quantity of pus was withdrawn from the left labium. Two or three days after this the abscess pointed on the inside of the left thigh. Incision was made with a bistoury, and about half a pint of pus was removed. Complete relief of all the symptoms ensued. The patient walked about in three weeks, but wore a hip-binder for several months. Recovery was complete."

The symptoms of the disease may be divided into two stages:

(1) A period of general disturbance and local disturbances with intestinal or vesical symptoms;

(2) A period of the formation of the tumor above the symphysis.

The urinary troubles are not constant, and, with the intestinal disturbances, would rather seem, as Bouilly says, to point to the reaction on the peritoneal surface.

In the earlier stages digestive troubles are so marked that some writers have been led to assign to them an important rôle in the causation of the disease. This period is marked by violent colic, constipation or diarrhea, a sense of weight in the pelvis, nausea and vomiting; there is an anxious expression, and the patient suffers from the symptoms of a mild cystitis. The hypogastric pain is almost constant, and is increased by exertion.

In the second period, characterized by the formation of the tumor, after from 3 to 10 days there is a distinct induration above the symphysis, extending upward with its base below. A larger tumor presents the appearance of a bladder distended by urine, lying on both sides of the median line, sometimes more on the one than on the other. The tumor is well localized and sometimes is distinctly fluctuating, while at other times it forms an indurated mass which has even been mistaken for a neoplasm.

The further course of the disease may, in a considerable percentage of cases, advance to complete resolution, with a disappearance of pain, and of fever, if it exists.

If resolution does not take place the parts may continue for a long time in a condition of induration.

Suppuration, which occurs as a rule, takes place with exacerbation of all the local discomforts accompanied by pelvic pain and tenesmus. The abscess may point above the symphysis or at the umbilicus or down in the vagina. Villiers, who has studied the termination of these inflammations more particularly, cites 5 instances in which resolution occurred, 3 in which the parts remained indurated, and 50 in which the termination was by suppuration.

The 50 cases ending in suppuration give the following history:

Seventeen times the pus was evacuated by an incision, generally in the median line above the pubis;

Ten times the sac ruptured into the peritoneum, resulting in an immediate violent peritonitis;

Ten times the opening was at the umbilicus, twice close to it, and, in Boyer's case, the discharge took place both at the umbilicus and at the pubis;

One case opened into the bladder;

Three cases discharged into the small intestine;

Two cases discharged by the rectum;

One case discharged by the cecum;

Six remaining cases terminated in a variety of ways: in one the autopsy showed pus in the subperitoneal cellular tissue, and an abscess of the prostate; in another, with fracture of the pelvis and diastasis of the symphysis, death took place from purulent infection, with a large abscess in front of the bladder communicating with the fracture; in an infant 13 days old there was a phlebitis of the umbilical vein and death from purulent infection; in a patient 65 years old, with hypertrophy of the prostate and retention of urine, the autopsy showed a large subperitoneal abscess extending up to the diaphragm, with ulceration and perforation of the bladder; the fifth case had an inflammation of the pre-vesical space following an acute inflammation of the right seminal vesicle,

followed by recovery; the last case, in a seamstress 31 years of age (*Progrès méd.*, Par., 1885, 2s., i, 441), had a chronic urethro-vaginitis.

On entering the service of Prof. Guyon, this last case presented the appearance of a patient in the last stages of phthisis. The whole hypogastric region from the pubis to the umbilicus was swollen and painful to pressure, resonant on percussion, and hot, but without any doughy sensation or redness of the skin. The vagina was greatly swollen and the uterus fixed. She was also passing pus with her stools. The urine was passed with violent and painful effort and contained a thick muco-purulent deposit. At the autopsy a well defined collection of fetid pus was found, limited by the anterior abdominal wall, the symphysis pubis, and the anterior face of the bladder; there was no communication with the peritoneum or with the cavity of the pelvis. The cause of the infection was undoubtedly the transmission of the pyogenic organisms through the intensely inflamed vesical walls to the cellular tissue of the cavity without destruction or suppuration involving the intervening tissues.

Causes.—An examination of a number of clinical histories reveals the following important causes of prevesical inflammation:

- Contusion;
- Inflammation of the symphysis;
- Necrosis of the symphysis;
- Fracture of the pubis;
- Penetration of a foreign body, as a bullet;
- Cystitis and urethritis;
- Calculus and ulceration of the bladder;
- Rupture of the bladder;
- Rupture of the cervix uteri;
- Suppurative disease of the uterus or adnexa;
- Suppuration around the vermiform appendix;
- Phlebitis in an infant;
- Perirectal phlegmon;
- Typhoid fever.

For typhoid fever as a cause see J. Labuze, *Thèse de Paris*, 1871; and Wenzel Gruber in Virchow's *Archiv*, 1862, xxiv, 182, giving a well described autopsy.

Diagnosis.—It is important that a diagnosis should be made as early as possible on account of the liability to confuse these affections with certain intraperitoneal diseases. It is also exceedingly important on account of the liability of the abscess to perforate the peritoneal cavity and cause death.

In the early stages of the disease it is difficult to make an exact diagnosis,

on account of the wide distribution of the pain, which is the only indicator as to the existence and location of the affection. Later, after carefully excluding other abdominal affections—above all, an appendicitis—the attention is directed more particularly to the pelvis, and, by some more or less well defined vesical symptoms, to the bladder, when a thorough bimanual examination may reveal an area of unusual tenderness behind the symphysis and in front of the bladder, which the surgeon will then watch with particular care.

The bimanual examination is best made with the bladder emptied, without anesthesia, by pressing up through the anterior vaginal wall at a point just behind the neck of the bladder, and pressing down over the top of the symphysis, so as to feel its posterior surface and the areolar tissue lying behind it.

At a later stage of the disease, when the tumor has formed, the diagnosis, although not so difficult, may not be easy. The tumor looks much like a distended bladder and is, at first sight, generally mistaken for one. This error is corrected by passing a sound and emptying the bladder when the tumor still persists without alteration in size. One of the most characteristic signs is that the swelling is in the median line and extends equally, or almost equally, on both sides, often showing a depression in the middle due to the linea alba; in other words, it appears limited by the semilunar lines of Douglas extending along the outer borders of the recti. The limit above may also be sharply defined by the semilunar fold, although in the more advanced stages the disease may extend up to the umbilicus or above it.

The doughy sensation is evidence of the involvement of the skin, and shows the more superficial nature of the inflammation as contrasted with intraperitoneal affections.

Where the affection of the prevesical cellular tissue is secondary to a uterine affection or to an abscess surrounding the vermiform appendix, it is not so important to make a diagnosis of the sequelæ as of the original focus of the disease, although it may be important, after opening the abscess near its focus, to discover the avenue of communication, and to make a counter opening over the pubis so as to secure a good drainage.

We think it may be laid down as a safe rule that when a prevesical inflammation complicates any vesical condition, whether cystitis, ulceration, calculus, or prostatic disease, immediate operation and thorough drainage should be done.

Differential Diagnosis.—Prevesical phlegmon must be distinguished from the subumbilical phlegmon, which may extend from the region of the umbilicus downward; this has been particularly described by A. Heurtaux, of Nancy (*Bull. et mém. Soc. de chir. de Paris*, 1877, iii, 641). The affection described by Hertaux always gives a history of beginning below the umbilicus, results in

the formation of only a small abscess, and is not associated with any urinary disorders.

Prevesical phlegmon is also to be distinguished from a tumor or phlegmon in the abdominal wall by the fact that the latter rarely occupies both sides of the linea alba, and bimanually, in a woman at least, presents no signs of an accumulation in front of the bladder or behind the pubis.

In one such case the decided induration and the slow progress of the affection led the consultants to form a diagnosis of an osteosarcoma. Although there was almost no fever, and no fluctuation could be felt, the fact that the patient had been shot in the right side in the campaign of 1870-1871, and that the ball had never been found, should have put the consultants more on their guard. (See N. A. Gérardin, *Disser.*, 1879, p. 75.)

The differential diagnosis may be more difficult in the case of an adherent dermoid tumor, an extra-uterine pregnancy, or a tubal or ovarian abscess lying in front of the uterus, adherent to the peritoneal surface of the bladder and the anterior abdominal wall. In such cases the suppurating tumor may perforate the prevesical space and involve it as one of the associated phenomena in the course of the development of the disease. One of the worst cases of pelvic inflammation we have ever seen was that of a young woman who came under our care about 9 years since, with an extensive induration of the vaginal vault investing the bladder.

A fibroid tumor of the uterus springing from its anterior wall and lying behind the symphysis ought not to be mistaken after a careful bimanual examination for the affection under consideration.

After a review of the literature, we are constrained to say that, in all cases where there is a slow development of a large abscess pointing above the symphysis, the examiner must bear in mind that it may be simply due to the extension of an abscess from the vermiform appendix.

Treatment.—The guiding principle in the treatment of these inflammatory affections should be free evacuation and free drainage, as far as possible in a dependent position, as soon as the existence and location of the inflammatory focus are determined with decision. As Bernutz said long since (*loc. cit.*), in discussing the prognosis in suppurative affections of the abdomen: "Aside from the dangers of extensive suppuration and of their continuance, liable to bring about a fatal hectic fever, we ought also to dread the risk of the pus pointing toward the abdominal cavity instead of the outside."

When a well defined abscess is formed, a large opening should be made, preferably in the median line just above the symphysis, not less than 4 to 6 cm. in length, extending upward; in this way a pint or more of extremely

fetid pus often finds prompt exit. In women it is of the utmost importance to find, if possible, a fluctuating area, or a spot in close relation to the abscess cavity, discovered by passing a sound into the cavity from above. A free opening made in this way into the vagina affords the best possible drainage. Care must be taken in making such an opening not to cut into the bladder, and not to divide a ureter. These accidents can be avoided by determining the position of the bladder by a sound within it, and by making an incision parallel to, but at a distance from, the ureteral fold. If nature has opened the abscess up near the umbilicus, it is then well to make a large counter opening above the symphysis, as there will be little tendency for the disease to ameliorate so long as the pus merely overflows to a high opening.

At the time the opening is made, the cavity should be explored in all directions with a finger, and an effort be made to discover whether the pus has burrowed into the pelvis or into the iliac fossa. While exploring the cavity, endeavor also, if possible, to discover some local cause for the infection, examining the symphysis pubis and examining the bladder bimanually. The cavity should then be thoroughly washed out and wiped with gauze, and then loosely packed with washed-out iodoform gauze, which may be left in for a week or longer, until there is some sign of reaction, local or febrile, when the gauze should be removed and the cavity washed out daily with a weak solution of boric or carbolic acid or some other mild antiseptic. Enough gauze should afterwards be kept in the opening to keep it thoroughly patulous.

LITERATURE.

Bernutz, "Phlegmons de la paroi antérieure de l'abdomen," *Arch. gén. de méd.*, 1850, lxxxiii, 129.

Bouilly, "Tumeurs aiguës et chroniques de la cavité prévésicale," *Thèse de Paris*, 1880.

Pauzat, *Gaz. méd. de Par.*, 1880, li, 448; 493; 543; 572; 617.

—, *Gaz. méd. de Par.*, 1883, liv, 426.

Villiers, "Des terminaisons du phlegmon prévésical," *Thèse de Nancy*, 1885.

CHAPTER XXXVII.

TUMORS OF THE BLADDER.

Our knowledge of tumors of the bladder is an acquisition of the past 100 years, more especially of the last twenty-five. Chopart mentions vesical tumors in his work, "*Traité des maladies des voies urinaires*," 1791-2, and calls attention to the associated hematuria, while Civiale (1843) distinguishes between benign and malignant tumors and enters into a more or less exhaustive description of these broad groups. Vesical pathology in a real sense, however, was born with Virchow's "*Cellular Pathology*," which first enabled the surgeon to distinguish clearly between the varieties of tumors, and all that was then needed to give practical effectiveness to this scientific analysis was methods of examination by the Nitze water cystoscope and the open-air cystoscope. By such direct inspection the surgeon was able to recognize a tumor sufficiently early to offer hope of permanent cure in the great majority of cases.

Right on the heels of the methods of classifying tumors and discovering them in their early stages, came such aggressive operative procedures as Trendelenburg's wide transverse extraperitoneal exposure of the interior of the bladder (1890) followed by Harrington's bold transperitoneal operation (1893). The total extirpation of a bladder extensively affected with malignant disease was accomplished by Bardenheuer in 1887.

The subject of vesical pathology has been further elucidated by the painstaking studies of Thompson, Küster, Guyon, Clado, and Albarran, until to-day there seems but little to desire beyond the more effective coöperation of both patient and practitioner in securing an earlier recognition of the disease, thus enlarging the field of radical operation in the infiltrating tumors and anticipating the wide diffusion of the vesical papillomata.

The diffusion of cystoscopic methods in the hands of a large number of urologists has also advanced the surgery of the bladder, step by step, from the first tentative and imperfect extirpation of simple pedunculate tumors by the removal of the tumor with a piece of the bladder mucosa, to resection of a large part of the bladder with perhaps transplantation of the ureter, and even total extirpation.

CLASSIFICATION.

Bladder tumors are either primary, secondary, or metastatic; the last are rarely found. Primary tumors originate in the walls of the bladder and, as they grow, either project into its cavity, when they spring from its inner coats, or infiltrate its walls, converting the soft, flaccid, expansible organ into a rigid shell.

Secondary growths involve the bladder by extending from a neighboring organ; especially noteworthy in this respect are cancers of the prostate, which, owing to the peculiar relations of the organ to the neck of the bladder, readily push out into its lumen, when it may be difficult to distinguish, by a mere naked eye inspection, whether the growth is primarily vesical or from the outside.

It was the comparative rarity of primary cancer of the bladder in women which suggested to Klebs and Küster that it was found more frequently in men because it probably originated in the prostate gland. Motz, who examined 87 vesical neoplasms in the Guyon collection, demonstrated that not one of these infiltrating tumors was a primary carcinoma of the bladder. Montefort, in examining 78 cases of epithelial tumors of the bladder in general, found the prostate as the source of the growth in 35 per cent.

In women, cancer of the cervix uteri, commonly in its later stages, infiltrates the base and posterior wall of the bladder, causing a bulbous edema of the mucosa. Carcinoma and sarcoma of the urethra also extend upward and involve the bladder. The secondary tumors of the bladder are, as a rule, of only diagnostic interest, as they are rarely operable. Occasionally, however, in cancer of the cervix, the uterus, with more or less of the base of the bladder, can be removed, giving hope of permanent cure, especially if massive doses of radium or mesothorium radiation are used.

Tumors of the bladder may be classified, from the standpoint of their origin, as follows:

EPITHELIAL:

Papilloma

Cysts of the vesical mucosa

Adenoma

Carcinoma (including adeno-carcinoma and squamous-celled carcinoma)

Dermoid cysts.

GROWTHS WHICH SPRING FROM MUSCLE OR CONNECTIVE TISSUE:

Myxoma

Fibroma

Sarcoma

Myoma

Rhabdomyoma

Angioma.

Dermoid tumors, rhabdomyomata, and chondromata are aberrant forms.

GENERAL CONSIDERATIONS.

F. S. Watson (*Ann. Surg.*, 1905, xlii, 805), in a thorough-going study of these tumors, discovered 243 to be benign and 410 malignant in an analysis of 653 cases.

Von Frisch (*Wien. klin. Woch.*, 1907, xx, 1205), in a series of 300 operations, found 3 cases in children—9, 11, and 13 years old; 9 were between 20 and 30 years; 20 between 30 and 40; 70 between 40 and 50; 76 between 50

FIG. 570.—SIMPLE PAPILLOMA. The small pedicle is composed of dense connective tissue, while the tumor itself is made up of fine connective tissue with vascular threads, supporting more or less fused masses of vesical epithelium. There is no evidence of malignancy. Suprapubic incision, and resection of posterior bladder wall with tumor. Recovery. No recurrence a few months after operation. (From J. T. Geraghty. x 5.)

and 60; 112 between 60 and 70; and 10 between 70 and 79. There were 256 in men and 44 in women. As to the microscopic character, 3 were adenomata, 2 of them in men between 50 and 60, and 1 in a girl of 13; 1 was a sarcoma in a boy of 11 years; 95 were carcinomata, and of these, 65 were papillary and 28 nodular, flat epithelial, partly lobulated, partly infiltrating medullary

FIG. 571.—PAPILLOMATOUS TUMOR OF BLADDER SHOWING TIPS OF PAPILLÆ AND FINGER-LIKE PROLONGATIONS. There is a small blood vessel in the central part of the papillæ, forming the framework on which the epithelial covering is built up. Patient aged 68. Suprapubic cystotomy; two pedunculated papillary masses were found in the lower left quadrant. These were excised and the wound closed with drainage. Discharged as well one month later. (x 135.)

carcinomata; 201 were of the class called benign papilloma, but serial section of these showed that there was a beginning of cancerous change in 107. This manifested itself in the form of atypical epithelial growths invading the connective tissue substratum, sometimes in the pedicle, and not infrequently in other parts of the connective fibrous framework in the form of little groups of epithelial cells in the lymph tracts. Von Frisch emphasizes the fact, therefore, that two-thirds of all these tumors must be characterized as malignant.

Papilloma.—The most characteristic tumor of the bladder is the papilloma.

This was at first considered benign, but, some unfortunate cases occurring, suspicion was awakened and surgeons then rapidly took exactly the opposite standpoint, one practically held universally to-day. Out of 88 cases Albarran found that 66, or 75 per cent., were malignant, while Mandlebaum and Zuckerkandl found 65 per cent. malignant.

FIG. 572.—AN APPARENTLY SIMPLE PAPILLOMA WITH A BASE ALMOST AS BROAD AS THE TUMOR IS HIGH. After the base had been removed by constriction, it might have given rise to a false diagnosis of simple papilloma. Suprapubic cystotomy. The entire base of the bladder, including both ureteral orifices, was invaded by the disease and a radical operation was out of question. The wound was therefore closed with drainage. The patient died 7 days later from an embolus. (x 62.)

Papillomata are pedunculate or sessile tumors, made up, as a rule, of innumerable little branching papillæ springing from the bladder wall at some point about its base; they are often multiple and show a marked tendency to recur at some other point upon removal.

The tumor is made up of connective tissue framework branching like a tree; the branches are covered with epithelium and many of them have the appearance of a coral tree or a cauliflower. The epithelium is in many layers, connected below with that of the bladder and spread over a highly vascular

connective tissue framework, which grows thicker toward the base (Figs. 570-573).

Some tumors are solid, resistant, and nodulated or mulberry-like (fibropapilloma); others are made up of delicate, floating fringes like algæ. When the protecting epithelial layer disappears, the papillæ often coalesce, adding to

FIG. 573.—SECTION FROM ANOTHER PART OF THE SAME TUMOR AS IN FIG. 572. This section is magnified 130 times and shows sarcomatous invasion of the deeper tissues.

the solidity of the mass. Vacuoles and spaces are seen, and sometimes well-defined cysts. If the circulation is interfered with, as in a sharp flexure of the base, the stroma becomes edematous, necrosis takes place, and an incrustation of urine salts begins to cover the tumor, which appears white instead of pink. The most satisfactory tumors from the operative standpoint have well-defined pedicles. They are often minute; again, they are as big as an egg, more or less completely filling the bladder. They are usually few and discrete, but we have seen the entire bladder studded on all sides, and, again, we have seen it choked

with a few large masses from 3 to 5 cm. in diameter, with smaller ones scattered about like young saplings. In over one-quarter of the cases the tumors are multiple. They belong to the base but spread out to the sides; we have twice seen a sessile mass growing down through the internal orifice well into the urethra.

When the bladder collapses without active contraction, and when it is at

FIG. 574.—PAPILLARY ADENO-CARCINOMA, WHICH, TO THE NAKED EYE, APPEARS TO BE A SIMPLE PAPILLOMA. (From G. L. Hunner. x 5.)

rest, the upper part rests in the lower like two saucers nested one in the other; the papillomata belong commonly to the lower saucer.

A papillary carcinoma may be the result of a transition from a benign to a malignant tumor, or it may be malignant from the first. A naked eye inspection cannot distinguish benign from malignant. Judd, speaking from a large experience, says: "In the group of malignant cases we have included papillomas and carcinomas." This is the safer assumption from a surgical standpoint and is protective of the best interests of the patient. Figures 574, 575, and 576 show the polymorphous character of the epithelial cells, with large, irregular nuclei and atypical proliferation. This character, associated with infiltration of the stroma, presents the picture of malignancy.

O. Zuckerkandl gives the following graphic description of this transition of a benign into a malignant tumor, first noted by Foerster in 1855: "The changes are noted in the epithelium of the villi and affect strikingly the relation between the epithelium and the stroma, especially about the pedicle. In a well-defined area the papillary epithelium shows alterations in the uni-

FIG. 575.—HIGH MAGNIFICATION OF TUMOR SHOWN IN FIG. 574. Adeno-carcinoma showing high mucous cells with basal nuclei. (From G. L. Hunner. x 150.)

formity and arrangement of its cells. Numerous mitoses point to rapid cell multiplication, and the cells are found more crowded together than elsewhere, many being flattened out on the others. The nuclei lose the uniformity and arrangement of their cells. In some areas the villi are more fused, forming confluent epithelial masses in which the outlines of the once separate villi are no longer distinguishable, while only here and there can the sparse remains of the stroma with its vessels be found. At the border line between cells and stroma the cells are found invading the latter. There is no longer a sharply defined boundary; the lymph channels are invaded by the epithelial cells and are conveyed by them into the connective tissue layers. Note carefully that every group of epithelial cells found in the stroma is not to be taken as evidence

of cancerous invasion; such conclusions must be made only after studying a series of sections. The stroma so invaded manifests a lively inflammatory reaction and a small cell infiltration. The epithelial groups also break through into the blood vessels."

Cysts of the Vesical Mucosa.—Cysts of the vesical mucosa are not infre-

FIG. 576.—SECTION IN DEEPER PART OF TUMOR (ADENO-CARCINOMA) SHOWN IN TWO PRECEDING FIGURES. Showing the melting away of the epithelial cells into the myxomatous masses and the mucoid degeneration of the connective tissue. (From G. L. Hunner. $\times 74$.)

quently associated with a cystitis. A number of authors have reported a cystic degeneration at the base of the bladder, sometimes associated with cysts in the ureter. In size, they vary from a few millimeters to a centimeter in diameter; occasionally they are large and pedunculate.

Brongersma (*Ztschr. f. Urol.*, 1908, ii, 489) cites 2 cases—a woman of 52, and a man of 32 years—with a study of the literature. The tumor in the woman was about the size of a walnut, with a base 1 cm. in diameter. It was situated near a normal left ureteral orifice. The contents were clear, and the

consistency that of glycerin. The patient complained of pain in urinating and of a stoppage. The walls of the cyst were made up of vesical mucosa, a slightly edematous submucosa with dilated vessels, here and there groups of leukocytes, and a normal muscular layer, followed by a layer of connective tissue with a lining of epithelium.

FIG. 577.—SQUAMOUS-CELLED CARCINOMA DEVELOPING ON A CASE OF EXSTROPHY OF THE BLADDER. (x 68.)

Adenoma.—Adenoma is an epithelial tumor of an infiltrating character. The surface is nodular; the mass made up of a connective framework, with penetrating epithelial canals. The epithelium lining the tubes is in a single layer and is never heaped up or distributed atypically through the tissues.

Leguen ("Traité chirurgical d'urologie") cites 12 cases. The microscopic examination shows a cylindrical epithelium developing at the expense of the mucous glands of the bladder. The attachment is usually at the base, but the growth may spring from the vertex, where no glands are found. Nitze removed an adenoma as large as an apple.

Carcinoma.—Carcinoma of the bladder is an infiltrating epithelial tumor, spreading irregularly from its base through the vesical walls and ultimately converting them into a rigid shell. As the tumor spreads, it breaks down, and

the central part forms a bleeding, ragged, ulcerating surface, while the disease continues to extend out through the walls, along the vascular channels in all directions. The squamous-celled epithelioma is made up of irregular, anastomosing cellular plugs, penetrating the connective tissue and the muscles. This form of epithelioma may be derived from a vesical-leukoplasmia, a result of a preëxisting inflammation (Figs. 577, 578 and 579).

The carcinoma varies in form according as the epithelial elements predominate (medullary), or the connective tissue is more abundant (scirrhous). A balanced proportion between these two essential elements gives the carcinoma simplex.

FIG. 578.—CARCINOMA OF THE BLADDER. Age 67. Suprapubic incision. Papillomatous tumor (squamous-celled carcinoma), anterior wall very friable. The tumor was bisected and cut away with a small margin and the wound closed with catgut. Drainage. The patient was well 6 years later and could retain urine for 8 hours. (Path. No. 5089, H. A. Kelly. $\times 5\frac{1}{2}$.)

From a practical clinical standpoint, the carcinomata vary all the way from those which are liable to be mistaken for simple papillomata, or which cannot be distinguished until they are removed and examined microscopically, to

those which are flat, infiltrating, and ulcerated, and admit of no doubt as to their identity as soon as they are seen (Fig. 580).

Carcinomata often grow but slowly, and do not form metastases early.

When metastasis takes place it is usually in the regional glands or in the lungs. Figure 581 shows a secondary growth in the ureter.

An interesting development of a carcinoma in a diverticulum is shown in a case of Hugh H. Young's, Figure 582.

Dermoid Cysts.—Dermoid cysts are rare. They may be divided into 3

FIG. 579.—HIGHER MAGNIFICATION OF TISSUES AT THE BASE OF TUMOR SHOWN IN PRECEDING FIGURE, SHOWING CARCINOMATOUS INVASION OF THE MUSCLE. (x 70.)

groups: (1) the cyst is in the vesical wall and projects into the bladder itself; (2) the tumors are paravesical and attached to the bladder wall; (3) ovarian dermoids which have become attached to the bladder and often communicate with it by an opening. It is this last group in which hairs from the cyst, following the current of the fluids, have been passed by the urethra—"pili-miction."

Sänger (*Arch. f. Gyn.*, 1890, xxxvii, 100), who collected and tabulated 11 cases, occurring between 1859 to 1890, concluded that dermoids of the bladder are almost always ovarian tumors which have broken through into that viscus. In discussing the rare cases of dermoid cysts of the pelvic connective tissue, he

assigns them a place in our nosology as definite as that claimed for dermoids of the occipital region and of the orbital cavity.

Clado includes some of these paravesical cysts as tumors proper of the outer walls of the bladder, eccentric, as it were, and properly associated with cysts of the inner walls which develop centripetally and encroach upon the vesical cavity. He collected 7 paravesical tumors communicating by an opening with the

FIG. 580.—CARCINOMA SPRINGING FROM RETRO-SYMPHYSEAL WALL OF BLADDER. The drawing shows a sagittal view of the growth, and indicates its attachment, as well as its size and surface characteristics. It was removed by a suprapubic incision. (Mrs. D., July 8, 1901.)

bladder, 5 in men and 2 in women; in the latter there was no connection with an ovary. They appeared between the ages of 21 and 40 years. The usual site was the vesico-rectal septum beneath the peritoneum. In 2 cases the tumor occupied the vertex of the bladder, in 2 others it was at the side of the bladder. The tumor may attain a large size. Hall relates the case of a woman 50 years old who suffered during urination for 7 years, and who passed purulent urine. After the urethra was dilated, a little tumor attached to the posterior vesical mucosa was removed in fragments. It consisted of a tuft of hair two inches long, and hair bulbs were found microscopically. Thompson ("Tumors of

the Bladder," London, 1884, 63) reports a case in a woman 30 years old; he dilated the urethra and removed a pedunculate tumor made up of a thick layer of skin, fibrous tissue, sebaceous glands, and hair follicles (Fig. 583).

FIG. 581.—CARCINOMA OF URETER, SECONDARY TO PRIMARY GROWTH IN PROSTATE GLAND AND BLADDER. (S.; autopsy No. 1725.)

Stoeckel cites a case of Martin's in a child two days old, and one of Bogajewski's in a woman of 33, in which the tumor was pedunculate and attached to the base of the bladder and weighed 12 grams. It consisted of skin, hairs, fat, bones, and teeth.

Myxoma.—A myxoma is a muco-membranous, polyp-like tumor of the con-

nective tissue group, reddish-yellow in color, found chiefly in childhood — Nitze says, "almost exclusively in children under seven." Tumors of this character, often multiple, may sprout from a broad base, or they may be pedunculate. They may be edematous and closely resemble nasal polyps, being made up of myxomatous tissue and branching cells, with a rich, vascular network. They grow rapidly and return quickly after removal; the transition to sarcoma (myxosarcoma) is common; indeed, all tumors of this group are under sus-

FIG. 582.—SAGITTAL VIEW SHOWING CARCINOMA WHICH HAS DEVELOPED IN DIVERTICULUM OF POSTERIOR WALL OF BLADDER. Blood has flowed through the neck of the diverticulum and formed the large clot seen in the bladder. Whitish fragments of the tumor are interspersed through the clot. The blood clot was removed through a suprapubic incision, when the diverticulum was discovered and excised. (From Hugh H. Young, J. H. H., Feb. 12, 1909.)

picion as being, in part at least, sarcomatous (Fig. 584).

Fibromyxoma.—Schatz (*Archiv f. Gyn.*, 1876, x, 356) first described a fibromyxoma in a girl of 18, which he cured, after several operations, by inverting the anterior bladder wall, with its 4 x 4 cm. attachments, through the greatly dilated urethra, and resecting the bladder at this point.

Rumpel (*Dtsch. med. Wchnschr.*, 1908, xxxiv, 1855) reports a case of fibromyxoma in a boy 3 years old. The child cried on urinating and had a swollen abdomen, which had led to a suspicion of stone. On examination, the

bladder was found reaching to the navel, and there was a constant escape of urine (*ischuria paradoxa*). On introducing a catheter, a slight obstruction was felt. The cystoscope revealed a conglomeration of more or less spherical tumors, some covered with mucosa and some transparent and gelatinous, encircling the inner urethral orifice. Rumpel made a suprapubic opening and found the bladder wall thick and the tumors firmly attached; he cut through the mucosa and stripped out the growth, using both a cutting and a blunt instrument. After eradication, the entire area was seared with a Paque-
lin cautery; the bleeding was only slight. The bladder was then closed with a drainage catheter, and the little patient recovered. Examination showed myxofibroma, young mucous tissue with oval nuclei, and numerous communicating threads between cells, a homogeneous mucoid mass, with dilated lacunar capillaries.

These tumors appear at the age of 1 to 3, rarely as late as 5 years, and are closely allied to the sarcomata, myxomata, and fibromata. In a female child the tumors may even be forced out from the urethra by the straining. The leading symptom is retention of urine. The operation always consists in opening the bladder suprapubically and extirpating the growth. The prognosis is doubtful on account of the risk of recurrence. Radium (50-100 mgr.) enhances the prospect of a permanent recovery.

Brennecke (*Centrbl. f. Gyn.*, 1879, iii, 177) reports fibromyxoma in a woman of 34, whose main symptoms were cystitis and sudden stoppages in urination. After labor, the patient suffered intense bearing-down pains for over 2 days, when she finally expelled from the urethra a tumor the size of

Mucous band

—Microscopical appearance of a section of the skin covering the dermoid tumour.

FIG. 583.—THOMPSON'S CASE OF DERMOID TUMOR REMOVED FROM BLADDER. The microscopic section shows the various skin elements of a dermoid cyst. ("Tumors of the Bladder," London, 1884, 63.)

the kidney of a new-born child, which showed all the microscopic characteristics of a vascular fibromyxoma, and had evidently been abraded from its vesical attachment by the passage of the child's head.

Fibroma.—A vesical fibroma originates in the submucosa, growing out into the cavity of the bladder until it forms a more or less nodulated pedunculate tumor covered with normal or congested vesical mucosa. The term "fibrous polyp" is a confusing one, and ought not to be used for tumors of this group, as a fibrous polyp properly designates a papilloma in which there is an excess of fibrous tissue. Albarran, however, thinks that between fibroma pure and simple and papilloma pure and simple all grades can be established. A true fibroma is an enucleable tumor, made up of an enlargement of a dense network of fibrous tissue with but few vessels. The main vessels run between the mucosa and the tumor; they are, therefore, peripheral and do not plunge directly into the heart of the tumor and spread like the branches of a tree, as in a papilloma. This is the clear distinguishing mark between papilloma and fibroma.

Clado cites 25 cases between the ages of 20 to 70 (16 in men; 9 in women); 14 were situated at the base of the bladder. In one case (Gersuny) a tumor as big as an egg was found in a diverticulum of the bladder. In another (Jackson) the tumor was attached to the neck of the bladder and was forced out in every act of urination.

Legueu adds 3 more to Clado's list. Stoeckel (Veit's "Handbuch der Gynäkologie," 1907, ii, 520) reproduces a photograph of a little irregular nodulated mass made up of 3 rounded nodules with a smaller one between, just like a group of uterine fibroids. The whole mass was cut off by a wire loop through an open cystoscope.

Albarran showed a pedunculate lobulated tumor the size of a small nut attached back of a ureter.

E. S. Judd (*J. Am. Med. Ass.*, 1912, lix, 1788) shows 2 large fibromyomata removed from the bladder.

Sarcoma.—Sarcoma of the bladder is a comparatively rare connective tissue growth; Albarran, in a series of 89 cases personally examined, found 2. In a series of 53 well-established instances collected from the literature he found that in 49 in which the point of attachment was distinctly stated, the posterior or lateral walls were involved in 25, and the trigonum in 11, while the anterior wall alone was affected in 8. In 51 tumors, 15 were pedunculate, 21 sessile, and 15 infiltrating. Occasionally the tumor is seated near a ureteral orifice which it encompasses. A sarcoma cannot be differentiated macroscopically, although it is less likely to present villousities than other tumors. A simple sarcoma, which has undergone edematous swelling and degeneration, must be

FIG. 584.—MUCOUS POLYPS (MYXOSARCOMA) IN A GIRL. Enormous distention of bladder due to obstruction of urethral orifice. (Albarran's "Tumeurs de la vessie," p. 113.)

differentiated from a myxosarcoma with its characteristic stellate cells. They are not as likely as the carcinomata to present an ulcerating surface. With the growth of the tumor there is an involvement of contiguous structures, such as the vagina and the rectum, as well as deposits in intestines, lungs, or liver. The sufferers die of urinary infection, or of sloughing and peritonitis, or of pyemia.

About 10 per cent. are under 10 years; the remainder are distributed through the decades up into old age. The symptoms are tenesmus, hematuria, foul urine, much pain, incontinence, anuria, and cachexia.

Myoma.—A myoma develops at the expense of the muscular wall of the bladder, generally its inner coat. It is made up of an interlacement of smooth, muscular fibers, resembling a uterine tumor (Fig. 585).

William Belfield (*Wien. med. Wchnschr.*, 1881, *xxxi*, 326-710-890) classifies these tumors as:

(a) Those growing toward the lumen of the bladder; (b) those occupying the wall of the bladder; (c) those developing on the outside of the bladder. This is analogous to the familiar grouping of uterine myomata.

A fibromyoma is marked by the intermixture of fibrous tissue with the muscular elements. There is no tendency on the part of the vesical myoma to invade the neighboring tissues.

When the tumor is interstitial in character,

growing in the vesical wall, it may recur after removal.

The surface is smooth or largely lobulated; in 3 cases the tumor was covered with villous growths. It may ulcerate or become detached and be discharged in fragments.

Clado, in 5 cases, found 4 pedunculate and one sessile. Albarran collected 21, 4 of which showed malignant degeneration. When the tumor grows into the vesical cavity it may be pedunculate or sessile.

FIG. 585.—LARGE MYOMATOUS VESICAL TUMOR ARISING FROM ENTIRE TOP OF BLADDER AND FILLING VISCUS. It caused the anterior wall of the vagina to protrude as shown and the urethra was greatly shortened. Enuclation through the divided anterior vaginal wall was easy, but the patient, already profoundly septic, died soon after.

Polaillon and Le Grand, in 1888, removed a tumor weighing 3,200 grams, which was shown at autopsy to spring from the external surface of the bladder.

In 114 cases of tumors of the urinary bladder observed by Judd at the Mayo Clinic (Rochester) there were 2 cases of fibromyomata.

In 1899 A. Riegel wrote an inaugural dissertation on Myomata of the Bladder; this was published at Giessen, and brought together all the known cases.

Angioma.—The first observation of a tumor of the bladder to which the name of "angioma" is applied is in Gross' "Practical Treatise on the Urinary Organs," 1851. The patient was a woman, 72 years old, who had suffered from hematuria. At autopsy a soft, spongy, irregular cauliflower tumor was found. There is no histologic description, and the propriety of the name is doubted by Le Dentu. Albarran ("Les tumeurs de la vessie," 1892, 118) found a true angioma in a man 64 years old, who had suffered from hematuria similar to that due to a neoplasm. The patient was extremely exhausted by hemorrhage and died under chloroform at the operation by Guyon. A little tumor was found 2 cm. behind the trigonum, between the ureters; it was the size of a pea, soft, with a smooth surface, and of a deep violet color. It was attached to the bladder by a broad base. The bladder tissue was of a deep violet color on all sides. A microscopic examination showed large tortuous capillaries with ampullar dilatation, separated by only a little connective tissue. The vessels of the tumor lay just under the bladder epithelium, which was normal where preserved.

A case is reported by Robert C. Bryan (*So. Surg. and Gyn. Trans.*, 1909, xxii, 518) in a man 35 years old, who had irregular hematuria. The cystoscope showed a dark, broad, sessile tumor at the back part of the bladder as big as the thumb nail, projecting slightly into the bladder. Through a suprapubic opening the tumor was removed by abrasion with serrated scissors, and the base thoroughly seared with a Paquelin cautery. The pathologist reported a cavernous angioma of which 2 enlarged figures under high and low magnification are given by the author.

It is a little curious, considering their rarity, that von Soemmerring, in his work on Fatal Diseases of the Bladder and Urethra in Old Men (Frankfurt, 1822, 2nd ed.), should attach such great importance to a hemorrhoidal condition of the blood vessels of the bladder as a source of serious hemorrhage, devoting an entire chapter to the discussion of vesical hemorrhoids and hematuria arising from them. He notes also that hematuria may proceed from ulceration and from spongy tumors of the bladder (p. 165), basing his remarks on an autopsy made in 1799.

TUMORS OF THE BLADDER IN CHILDREN.

Tumors of the bladder in children require separate consideration. They are rare, so rare that Bokai, writing in 1878, had never made such a diagnosis. C. Steinmetz (*Dtsch. Ztschr. f. Chir.*, 1894, xxxix, 313) collected 32 cases, and G. Hüsler (*Jahrb. f. Kinderheilk.*, 1905, lxii, 133), to whom we are largely indebted, adds 14 more, all carefully tabulated. Of the 14, 6 were sarcomata, one fibroma, one fibroadenoma, one myxoma, one papilloma, one fibromyoma (a mixed tumor with an islet of cartilage), 2 rhabdomyomata, 1 doubtful. (See also E. Kaufmann, *Dtsch. Chir.*, 1902, liii, 381.) Fenwick declares that bladder tumors are rare in children, and, when they occur, are inoperable, incurable sarcomata; Albarran states that there are no tumors of the bladder in children which are not sarcomata or myxomata.

We believe that the diagnosis of myxoma (mucous polyp) must be made with unusual care to avoid error, as tumors of this group are unquestionably sometimes rhabdomyomata or sarcomata; for example, 2 of Albarran's operative cases rapidly relapsed and ran a "galloping course" to their exitus.

The only benign papilloma known in a child is the case of S. Spangaro (*Policlinico*, Roma, 1898, sez. chir., v, 127). The patient, a boy 3 years old, was operated upon and died. One of the tumors, the size of a hen's egg, had compressed the ureteral orifices and grown down into the urethra, which was choked.

In Hüsler's list of the benign tumors, 6 were in boys and 1 in a girl. They were multiple, with one exception, and pedunculate. It is an interesting fact that these tumors tend to lie near the neck of the bladder, accounting for the characteristic obstructive symptoms.

Darling (*Ann. Surg.*, 1905, xlii, 831) describes a sarcoma in a boy 4 years old, which ran a fatal course. The appearance of the bladder is well shown in Figure 3 in his article. A careful investigation of the literature of sarcoma of the bladder in children revealed in all some 18 cases.

The difficulty of deciding upon the exact nature of the growth is well shown in Darling's admirable micro-photographs. One field shows a myxoma covered with stratified cells. Again, the growth appears as a myxolipoma, vascular, and in one area so rich in cells as to simulate a sarcoma. A diagnosis was made of myxoliposarcoma, probably congenital. A portion of the growth justified the diagnosis of adenosarcoma, or adenomyxosarcoma. Again, it presented the appearance of a polymorphous cell sarcoma.

The symptomatology of these cases is well brought out in a little boy one

and one-half years old in Kaufmann's clinic; he began, when 4 months old, to dribble a drop or two of urine occasionally. Soon after this came straining and the passing of but little urine at each effort. In Darling's patient the urine was discharged in spurts. Once a clot blocked the urethra and caused a retention. Then came foul urine, fever, loss of weight, diarrhea, and a developing cystitis, the little patient suffering increasingly from pain. The abdomen was tender above the pubis and a rather firm mass was felt, about the size of an apple. After death, an edematous fibroma was found, with a severe cystitis and hypertrophy of the bladder wall, double hydronephrosis, and multiple striated renal abscesses. The tumor, made up of 2 small lobules, had a smooth surface and was attached at the trigonum by a pedicle 1 cm. broad.

FIG. 586.—RHABDOMYOSARCOMA IN A CHILD. The bladder is opened from above, showing the lobulated mass of tumors. (From Claribel Cone.)

Dr. Claribel Cone had a case of a little girl of 12, who had a rhabdomyoma sarcomatosum, which began in the upper vagina and invaded the bladder. Dr. Cone followed the case through to its distressing end, and then made an elaborate study of the growth. The neoplasm began in the upper vagina and invaded the bladder, causing painful micturition followed by complete retention. On catheterization 400 c. c. of urine were withdrawn. Later the patient suffered from incontinence. The bladder was found choked with large pedunculate, translucent, grayish pink, more or less telangiectatic tumors. Both

ureters were distended, and there were metastases in the lungs (Figs. 586 and 587).

There was a unique feature in the bladder—a peculiar layer of striped muscle fibers of the developed fetal type, the structural arrangement of which appeared to belong to the original bladder wall, inasmuch as they followed the

FIG. 587.—RHABDOMYOSARCOMA IN A CHILD. The tumor masses fill the cavity of the bladder, springing from its base, while the lengthened-out vagina is involved on all sides. (From Claribel Cone.)

deposition of the normal striped layers of the organ. These strands of developed striped muscular fibers had no demonstrable connection with the invading embryonic cellular tumor tissue found in the deeper coats of the bladder.

The symptomatology of tumors of the bladder in children is well depicted in one of Hüsler's cases. A boy 7 years old was first observed by his mother as taking an unusual time to urinate; then the urine began to dribble, and he

complained of pricking and burning in the glans. A month's time brought a constant escape of urine, with pains in the abdomen, retention, and straining, with occasionally a little bleeding. The boy became pale and had an anxious expression. There was marked urinary infection, and, under an anesthetic, a movable tumor about the size of a plum could be felt bimanually in the bladder. He died in three months, and at the autopsy a tumor was found which was at first diagnosed as a papillary myxoma. There was perforation of the bladder, with peritonitis, double hydronephrosis, and abscess of the right kidney. The tumor, carefully studied, proved to be a rhabdomyoma.

Often a diagnosis of stone in the bladder has been made by the family practitioner, so parallel are the symptoms. In introducing the catheter a slight resistance, readily overcome, has been noticed repeatedly at the internal orifice of the urethra.

A bimanual examination usually reveals the existence of a large tumor, and a small cystoscope will enable the clinician actually to inspect it. By emptying the bladder and injecting from 50 to 100 c. c. of a bismuth emulsion, an X-ray picture will show a large tumor, or group of tumors, standing out in bold relief like an island in the opaque medium. The tumor will not be mistaken for a stone if a metal searcher or a wax-tipped catheter is used.

Treatment.—The treatment presents some points of difference from that of such tumors in adults. First of all, if the condition is taken in hand early, before cystitis sets in or the general health breaks down, the prognosis is hopeful. A certain number of these tumors are not malignant, and these can be extirpated, either by splitting the capsule as in a fibromyoma, or by excision well outside of the pedicle in the case of a pedunculate tumor. Again, malignant tumors are often remarkably pedunculate in their earlier stages. Such a growth should be removed as radically as possible, and then the wound should be left open for a few massive treatments with radium (100-200 mgr.).

There is but one avenue by which to attack a vesical tumor in a child, and that is the suprapubic route.

SYMPTOMS.

The cardinal common symptom of bladder tumors is hemorrhage, first at intervals extending, perhaps, over months; later, it increases in amount, as the tumor grows in size or as other tumors form, becoming more constant and causing severe anemia, associated, in the malignant cases, with cachexia. As the

tumor grows there is increased difficulty in emptying the bladder, and there may be frequent urination.

A pedunculate tumor, situated in the anterior part of the bladder, is apt to cut short the flow of urine, acting like a ball and valve, or it may press on the ureter and cause a hydro-ureter.

In the later history of neglected or inoperable cases cystitis sets in, the tumor becomes necrotic and the infection spreads out into the tissues of the bladder wall, followed by absorption, with extreme malaise. At the same time the distressing tenesmus increases in severity, until not infrequently all the urine escapes involuntarily. A bimanual examination reveals the presence of a tumor in the bladder when it is very large or when the bladder walls are infiltrated. A mass of papillomata feels softish to the bimanual touch.

FIG. 588.—PEDUNCULATE PAPILLOMA SITUATED JUST IN FRONT OF RIGHT URETERAL ORIFICE. In the knee-breast posture, with air-distended bladder, the tumor hung just as shown. This is an admirable case for treatment with the electro-cautery directly applied to its pedicle. (B. San., June 15, 1902.)

There is no marked tenderness apart from a cystitis. A catheter draws off urine which is more or less bloody, alkaline, and full of bacteria in the more advanced cases; sometimes it contains little pieces of tumor which have sloughed off, but which can often be distinguished with the microscope. Unless the catheter is carefully passed it may provoke considerable hemorrhage.

This paradoxical condition may be noted: Although the patient urinates often and the bladder appears to be intolerant, it is possible to inject from 200 to 300 c. c. of fluid into the organ through the catheter.

The only certain method of making a diagnosis is examination of the bladder through the water cystoscope (Nitze and others) or direct examination through the open-air cystoscope (Kelly). Through the latter, the papillary tumor hangs like a bunch of grapes, if it is attached to the base or lateral wall of the bladder (Fig. 588). If the pedicle is slender it may pull out the bladder wall; and can also be easily handled and examined with a curved, blunt instrument. The red, fleshy papillary mass bleeds easily if it is touched at all roughly. When the bladder is choked with many tumors it may not be easy to recognize the individual ones.

The ulcerated area of flat carcinoma infiltrating the bladder walls is more or less characteristic in its earlier stages and is readily distinguished from the

papillary group of tumors. Any bossed, infiltrating, ulcerating mass of the bladder must be looked upon as malignant until the contrary is proved by the removal of a piece of tissue with a curette or by actual incision down onto the growth.

FIG. 589.—X-RAY PICTURE OF BLADDER INJECTED WITH BISMUTH SUBNITRATE SUSPENDED IN WATER. Diagnosis: Papilloma of bladder; note detail in form and surface. A A A are the tumors; B is the bismuth; C, air let into bladder before injecting.

A carcinomatous papilloma is to be suspected when the base is broad and there is an evident surrounding infiltration of the bladder wall. While diagnosing, the surgeon should carefully measure the tumor, using the end of an open cystoscope of known size as his measuring rod. In a bladder more or less choked with papillomata much useful information can be gained by injecting a bismuth emulsion sufficient to distend the bladder, but not to overshadow the papillomata (Figs. 589 and 590). An X-ray picture of this kind shows the

amount of available space not occupied by the papillomata and gives the relation of the sound area to the diseased portion of the bladder. One of us (Kelly) has operated twice recently on cases worked out in this way, which

FIG. 590.—X-RAY PICTURE OF LARGE PAPILLOMA ATTACHED TO RIGHT BASE OF BLADDER BETWEEN URETHRA AND URETER. The tumor was so large, and so completely filled the bladder that little could be seen with the cystoscope except a great fleshy bleeding mass. By injection, however, the bladder was found to be capable of containing 400 c. c. of fluid, while the X-ray shadowgraph shows perfectly that the huge mass is attached by a narrow pedicle and that if there are any other implantations they must be small. The tumor lies in a shallow lake of iodid of silver emulsion, which almost completely surrounds it; the narrow, dark streak on the patient's right side shows that the bladder wall is free all the way around to the narrow pedicle. The light area which surrounds the tumor and the dark shadow of the iodid emulsion mark the limits of the bladder wall, further distended by air. A, papilloma; B, silver emulsion; C, air circle; P, pedicle of tumor.

appeared at first sight inoperable from the extent of the disease as viewed through the cystoscope.

Sometimes bits of tissue are passed with the urine which, examined microscopically, enable the clinician to diagnose a papillary growth in the bladder, but not to decide whether the tumor is malignant or benign, inasmuch as the growth lies in the deeper tissues.

The discovery of a tumor in the bladder, if not too advanced, is an indication for prompt operation. Every tumor, in the interest of the patient, must be labeled malignant until the contrary is proved after its removal.

TREATMENT.

The treatment of every case of tumor of the bladder is by eradication at the earliest possible moment. The simplest tumors of the papilloma group tend to transformation into carcinoma, and, therefore, demand early and radical treatment. If this is true of the simple pedunculate forms, how much more of all forms which tend to infiltrate.

For this reason patients with a hematuria from an undetermined source should be referred to a specialist for exact diagnosis and early treatment. Every tumor of the bladder also demands radical treatment; half-way and superficial measures are never in order here. The tumor which has only been scraped away with finger nail or curette grows again with surprising rapidity. All tissues removed should be subjected to a thorough-going microscopic examination, to discover whether the case is one of simple papilloma in all its parts, or whether, toward its base or some other parts, there is a change; it is well in the present status of this subject to preserve the tumor for future reference. Also, every case of bladder tumor ought to remain under observation for several years and submit to inspection, at first at intervals of a few weeks, and later every few months. Recurrences are far better treated when small than after the growth has taken a fresh start and made much headway.

We refrain from quoting statistics as to final results in operations for vesical tumors, as, on account of the wide variations in the skill of the operators exploring this comparatively new field, they vary greatly. The mortality of a suprapubic extraperitoneal operation for a papilloma ought to be next to nothing. The immediate risk of a resection of the bladder for carcinoma will depend upon the technique of the operator and the efficiency of the drainage in case the wound breaks down. The ultimate result depends here, as in other

fields, solely upon an early operation and a wide extirpation. An advanced case has but little chance of a permanent recovery.

The following plans of treatment are available:

- (1) Transurethral snaring or pinching off of the tumor, which may be associated with a cauterization of its base.
- (2) Transurethral destruction by high frequency current.
- (3) Application of radium.
- (4) Removal by operation,
 - (a) by the vagina,
 - (b) suprapubic and extraperitoneal,
 - (c) transperitoneal.

(1.) **Snaring the tumor or pinching off a piece for cauterization** is a method which has passed out of vogue since the use of the high-frequency current.

We have treated papillary growths by injecting into the substance of the tumor, through the Kelly open cystoscope (No. 12), about 1-2 c. c. of a 10 per cent. formalin solution, which instantly coagulates all the contiguous tissues and causes a necrosis. We have also treated the tumor by plunging the knife of the galvano-cautery well into its base, turning the current and cooking it thoroughly. We owe this method of treatment to the remarkable work of Keating-Hart, chief among the pioneers. It has been especially developed in its applicability to bladder tumors by E. Beer (*J. Am. Med. Ass.*, 1910, liv, 1768). B. A. Thomas has also had considerable favorable experience.

(2.) **High Frequency Current.**—The bladder is thoroughly washed out, and if the patient has a cystitis a number of preliminary irrigations are given; the urethra is then distended gradually until it is easy to pass a No. 12 speculum open cystoscope (even 8 or 10 will do). About 25 c. c. of novocain solution are then thrown into the empty bladder, and after 10 minutes the patient is put in the knee-breast posture, the speculum introduced, and the bladder emptied with a suction bulb. The tumor is brought into view, examined carefully, and measured with the end of the speculum. The pedicle in particular must be studied to determine whether it is broad or narrow, and the exact site of its attachment must be noted. The presence of any other tumors must also be observed.

The insulated simple copper stem made up of 6-ply cable, or one special insulated copper wire cut off square at the vesical end, is now introduced and pushed directly into the tumor. If the pedicle is a narrow one, the application can be made there with a view to destroying it and sloughing it off. If the tumor is more or less sessile, then the application should be made to all points

over its periphery with the intention of invading and destroying as much as possible at one sitting.

The Oudin current, which strikes deeper into the substance of the growth, is turned on gradually, and the strength increased by degrees until the patient complains of some pain. A small separation of the electrodes, not over an $\frac{1}{8}$ of an inch, is best. The cooking and electrolytic effects vary with the

FIG. 591.—DEMONSTRATION OF METHOD OF FULGURATION THROUGH AIR-DISTENTION CYSTOSCOPE.

amount of current and the length of the exposure, which is from $\frac{3}{4}$ to a full minute.

The operator ought first to test out his apparatus and gain experience by shaping a piece of meat in the form of a polyp and driving the current into this. It is possible with a No. 12 cystoscope to hook the tumor away from the bladder wall and then introduce the positive pole also using the D'Arsonval current to burn away the pedicle. The current sears the tissues so much that any serious hemorrhage may be avoided. The current can also be used as a styptic or palliative measure in checking hemorrhage. (Beer.)

After the treatment of a large tumor, rest in bed for a day or two is advised.

It is, on the whole, best not to attempt to treat a large tumor or a large group of tumors in this way. The better plan is to extirpate the big masses by a suprapubic operation and then to follow up any recurrences with the electric treatment. We would, however, make an exception for a single large tumor with a small pedicle. If the tumor is small, the patient may go about her usual occupations. If the bladder is not previously infected there may be an aseptic de-

FIG. 592.—DESTRUCTION OF PEDICLE OF ARTIFICIAL TUMOR BY DIRECT APPLICATION OF ELECTRODES ON OPPOSITE SIDES (D'ARSONVAL CURRENT).

tachment of the mass of the tumor, leaving a small area or button for treatment next time. The treatments should be given at intervals of 1 to 2 weeks. A tumor the size of a marble can be destroyed in several sittings. Figures 591, 592 and 593 give a general idea of the application of this remarkable agent.

(3.) **Radium.**—Radium, either in the form of the emanation in glass or flexible rubber tubes or as radium bromid in metal tubes, containing from 50 to 100 milligrams, is of undoubted service. We have tested it in some advanced cases of malignant disease and witnessed a decided regression.

It can be applied through the urethra through an open cystoscope, the radium tube being attached at the end of a rod. It is easy to make repeated applications of 10 or 15 minutes' duration, under the direct control of the light, while the patient is in the knee-chest posture.

It is also easy to apply the radium to any particular part of the base of the bladder—after once locating the site of the lesion by a cystoscopic view—by introducing the pencil through the urethra, with the patient lying on her back, the application being controlled by a finger in the vagina. The simple metal tube is used, protected with a celluloid or aluminum cover, transmitting beta and gamma rays for an hour or more to the infiltrated bladder walls. Often

FIG. 593.—COOKING OFF THE PEDICLE OF AN ARTIFICIAL TUMOR. One electrode is applied to the tumor mass (a small piece of beef) and the other to the body of the patient (a large mass of beef on a plate). The arrow points to the shrivelling, thoroughly cauterized pedicle.

it will be of value to make a suprapubic incision for the introduction of the radium. Radium cannot supersede surgery, but it may be used after an apparently successful operation to destroy any invisible foci and enhance the chances of a permanent recovery, as well as to treat inoperable cases. The hope of more extensive value in radium rests on the employment of immensely greater doses, of from 500 to 1,500 mgr. ra. br. heavily screened with lead so as to cut off all but the gamma and deep, penetrating rays.

(4.) Removal by Operation.—(a) **EXTIRPATION OF VESICAL TUMORS BY THE VAGINA.**—This operation will doubtless be frequently undertaken in selected cases in the future. This method recommends itself, in women, in tumors

of the base, where the vaginal outlet is more or less relaxed, and the ureteral orifices can be distinguished and the ureters catheterized so as to protect them from injury. The vagina can be split with the bladder or separated from it, as in operating for a cystocele; the exposed bladder is opened and everted or

FIG. 594.—EXPOSURE OF BLADDER BY MEANS OF TRANSVERSE INCISION ABOVE SYMPHYSIS.
The skin is divided and the forceps grasp the deep fascia, exposing the recti muscles, with the linea alba separating them. (Trendelenburg's exposure, a cadaver study by H. A. Kelly.)

pushed down into the wound from above, and the tumor excised; the adjacent bladder walls can then be brought snugly together by careful suturing; and lastly, the vagina is closed under the bladder. In some favorable cases even the vertex or other distant areas of the bladder can be made to present through a long longitudinal incision in the base of the bladder.

(b) **SUPRAPUBIC EXTRAPERITONEAL CYSTOTOMY.**—Suprapubic operation

for the removal of tumors of the bladder is advisable in all cases where the papillomata are extensive and large, where there is early malignant disease of the bladder wall, or the tumor cannot be reached through the urethra, as when it is lodged in a diverticulum.

FIG. 595.—EXPOSURE OF BLADDER BY MEANS OF TRANSVERSE INCISION ABOVE SYMPHYSIS. Linea alba divided and recti drawn apart. The bladder is inflated with air by means of the hand between the thighs compressing a rubber bulb. A transverse roll of the peritoneum which has not been opened is seen above the bladder.

The advantages of the extraperitoneal operation are that in the case of a coincident cystitis the peritoneum is not infected, and in case of any irregular or infected wound a broken-down incision will only result in a free drainage through a suprapubic opening.

The exposure to be described is a modification of that of Trendelenburg in

1890 (*Samml. klin. Vortr.*, Leipzig, 1890, No. 355), and advocated by Stoeckel (Veit's "Handbuch der Gyn.," 1907, Band 2, 532).

The steps are a transverse incision through skin, fat, and deep fascia, about an inch above the pubes. The exposed recti are then pulled apart without

FIG. 596.—EXPOSURE OF BLADDER BY TRANSVERSE INCISION ABOVE SYMPHYSIS. The bladder is now packed off with 2 silk sutures, as shown, and divided transversely.

cutting them. The space of Retzius is exposed, and the bladder, which is now blown up with air, comes readily into view. It, too, is opened transversely and at once affords a splendid view of the entire interior, if the pelvis is well elevated (Figs. 594 and 595).

In exposing the bladder the operator ought to take the utmost care not to rub off or injure the network of fibrous fascia investing it on all sides. In closing the bladder the vesical walls are first approximated with a continuous

suture of fine chromic catgut, interlocking and reaching through the muscular walls to the mucosa. The sutures must be passed close together (about 3 mm. apart) so as to prevent leakage. After closing the bladder walls proper, the

FIG. 597.—EXPOSURE OF BLADDER BY TRANSVERSE INCISION ABOVE SYMPHYSIS. Showing the amount of room given by the transverse opening of the bladder, without cutting the recti. The urethral and the ureteral orifices are clearly shown.

fibrous fascia, which has been carefully preserved for this very purpose, is next drawn snugly over the line of union by an additional fine chromic gut suture. If the bladder has been detached too far from the symphysis, one or two sutures should be placed through its vertex and these, together with the attachment of the rectus muscles, will hold it up in better place (Figs. 596 and 597).

The walls of the abdomen are reconstructed in the reverse order to that in which they were incised. We use about four mattress Pagen-

stecher sutures to reunite the fascia over the rectus. We think it is safer to make a little stab wound above the symphysis and insert a little protective drain here for 4 or 5 days. The entire operation for suprapubic cystotomy is well shown in Figs. 598-602.

The method of handling a papillary tumor is as follows: A pedunculate tumor should be grasped with care to avoid tearing its friable tissues. If the tumor has a pedicle, this should be grasped by a forceps well away from the vegetating masses, lifted up, and packed off on all sides (Figs. 603, 604 and 605). The Paquelin cautery is then used to burn off the tumor, its use being continued for about 30 seconds at a cherry-red heat, converting the pedicle of the tumor into a transparent parchment-like band. This serves also to destroy any papillomatous tissues invading the pedicle, and extends, as it were, the field of operation out onto the wall of the bladder, which has been pulled up. It also serves to check any hemorrhage. Any tendency for the leaflets thus

FIG. 598.—AIR DISTENTION OF BLADDER BY MEANS OF RUBBER CATHETER, ATTACHED ON THE OUTSIDE TO A BULB, IN THE OPERATION OF SUPRAPUBIC CYSTOTOMY. The bladder is not distended until the abdominal wall has been incised. As the assistant presses the bulb, the bladder rises up and becomes a tense bag in the incision. The peritoneal reflection is also lifted up and usually clearly outlined. On incising the bladder itself, the separate layers retract successively, as they are severed, and finally the bluish, glistening mucosa bulges through the opening, as shown in drawing. In closing the bladder the most important layer is the perivesical cellular tissue, which ought to be disturbed as little as possible in any vesical operation.

FIG. 599.—THE SUCCEEDING STEP IN SUPRAPUBIC OPENING OF BLADDER. (See last figure.) The open bladder shows a papilloma seated on the opposite wall. (R., Feb. 25, 1908.)

FIG. 600.—NEXT STEP IN SUPRAPUBIC REMOVAL OF PAPILLOMA OF BLADDER. The posterior wall of the bladder is inverted into the incision by means of the guy stitches. The incision, as indicated by the dotted line, allows the removal of growth with considerable healthy bladder on all sides. In non-malignant growths only the mucosa of bladder need be removed.

FIG. 601.—NEXT STEP IN OPERATION SHOWN IN TWO PRECEDING FIGURES. The defect in the bladder from removal of the tumor is being closed with figure-of-eight catgut stitches. Note the intact bladder muscle at the bottom of the wound.

seared to separate and bleed can be checked with a continuous fine catgut suture.

When the tumor has a broader base (Fig. 599), and it cannot be lifted up so as to secure a wide pedicle for cauterization, then we may follow another plan (Figs. 600-602). The vesical mucosa is lifted up, so that the entire base of the bladder, if need be, is drawn well up into the wound and, even in a favor-

able case, well out onto the wound and under the growth; the entire mucosa is separated in this way by a blunt dissection. Any penetrating vessels can be caught before cutting and tied. If the tumor is malignant, then the whole thickness of the bladder wall must be cut through at a considerable distance from the infiltrated margins. After such an incision the vessels are carefully ligated and the walls reunited from side to side by a series of interrupted or continuous chromic gut sutures. We have seen the urethra fringed with the papillary growths, in one case extending well down into its lumen. When not malignant, they can be removed in this situation by traction, overting the mucosa into the bladder and passing sutures to hold it before

FIG. 602.—FINAL STEP IN OPERATION SHOWN IN PRECEDING FIGURES. The posterior wall of the bladder is released and has dropped back into place, while the suprapubic opening is being closed with figure-of-eight stitches.

cutting it. The muscular tissues are laid bare, but are at once covered again with the transplanted mucous membrane. Again we have freely burned off a collarette of tumors at the urethral orifice. They did not return and the patient remained well.

When a ureteral orifice is involved to such an extent that the mass cannot be dissected away without risk of closing the opening in the subsequent suturing, one may then resort to Leguen's plan of passing a catheter up the ureter and then dissecting it free on all sides. With the stiff catheter in its lumen, the ureter can then be pulled out and dissected up as far as necessary, amputated, and sutured, projecting into the bladder at any desired point posterior to its normal embouchure. The wound made by the excision is then easily closed with catgut sutures (Figs. 606 and 607). With a short proctoscope, 2.5 cm. in diameter, and a good light, one should inspect all parts of the blad-

FIG. 603.—EXPOSURE OF PEDUNCULATE PAPILLOMA NEAR RIGHT URETERAL ORIFICE THROUGH SUPRAPUBIC INCISION. (Mr. B., San., Oct. 26, 1909.)

FIG. 604.—REMOVAL OF PAPILLOMA SHOWN IN LAST FIGURE BY CLAMP AND CAUTERY METHOD. The bladder wall is carefully protected with gauze; the heavy clamp catches and crushes the pedicle of the papilloma, which has been greatly lengthened by an upward pull. The papilloma is severed from its connections by the cautery, as shown in figure, and the stump thoroughly charred.

der walls to observe any little tumors just sprouting. After extirpating all the tumors, it is our custom to follow a plan recommended by one of us (Burnam) and flood the interior of the bladder with pure alcohol to destroy any abnormal epithelial cells which might remain and become attached to it, forming a nucleus of a new growth. We believe in closing the bladder completely in these cases and draining with a mushroom catheter through the urethra. The bladder is kept sweet by irrigating twice a day with a warm boric acid solution, and throwing in one or two ounces of a nitrate of silver solution (1-1,000).

FIG. 605.—APPEARANCE OF BLADDER AT CLOSE OF OPERATION PICTURED IN PRECEDING DRAWINGS. The pedicle is converted into a thin, almost translucent ribbon. Three weeks later, cystoscopic examination showed such perfect healing that no scar could be found.

(c) TRANSPERITONEAL CYSTOTOMY.—F. D. Harrington (*Ann. Surg.*, 1893, xviii, 408) first described a method of operating upon the bladder in a bad case of chronic

cystitis, by opening the peritoneum from umbilicus to pubes, with the pelvis elevated, and then packing off the surrounding abdominal cavity and opening

FIG. 606.—COMPLETION OF SUPRAPUBIC OPERATION FOR REMOVAL OF VESICAL TUMOR. The growth has been excised. The closure of the bladder is made by up and down in place of transverse sutures. (See next figure.)

the bladder freely, cutting directly through its peritoneal surface for the purpose of doing any intravesical operation.

The reasons for adopting this new approach to the interior of the bladder are expressed by the author in the following words: "All of these (suprapubic extraperitoneal) methods are imperfect and give the surgeon only a limited view of the bladder. If we wish to demonstrate the bladder on the cadaver in

S y m p "

FIG. 607.—COMPLETION OF SUPRAPUBIC OPERATION FOR REMOVAL OF VESICAL TUMOR. The first suture tied and additional ones placed, as shown. (See previous figures.)

the clearest possible manner, we do it by laparotomy. . . . The superiority of the intraperitoneal over the suprapubic incision as a means of reaching and operating upon the interior of the bladder is very decided. . . . Through the peritoneal incision the cut edges of the bladder can be drawn up toward the surface and even outside the abdominal walls" (Figs. 608 and 609).

Dr. Charles H. Mayo (*Ann. Surg.*, 1908, xlviii, 105), commenting upon the frequent failures in operations upon the bladder for tumors, quoting Watson's statistics, strongly advocates the transperitoneal operation for extensive exsective operations as affording an opportunity of doing a more thorough and radical operation.

Dr. E. S. Judd (*J. Am. Med. Ass.*, 1912, lix, 1788), in a table of 114 operations, gives 32 as transperitoneal, leaving out those cases which were found to be inoperable and 5 others. There remained 33 operated upon by the suprapubic extraperitoneal method; in other words, in the hands of the distinguished clinicians at Rochester, the Harrington-Mayo transperitoneal operations include about 50 per cent. of the cases.

We think, then, that it is safe to conclude from these eminent authorities that when the disease involves the peritoneal portion of the bladder, or when it

is easier to extirpate it by cutting boldly into the peritoneum and treating the affected area entirely irrespective of the peritoneum, we ought to adopt this plan. This applies with especial force to the male bladder. However, let us express our conviction that with a transverse incision in the abdominal walls and another wide one in the bladder, all excuse for doing a transperitoneal

FIG. 608.—CLOSURE OF TRANSPERITONEAL OPENING IN BLADDER. I. Shows the peritoneal surface of the male bladder and the method of closing the bladder wound by inverting the bladder edges by means of the Connell sutures. (Harrington's operation. Charles H. Mayo, *Ann. Surg.*, 1908, xlviii, 105.)

FIG. 809.—CLOSURE OF TRANSPERITONEAL OPENING INTO BLADDER. II. Showing the closure of the first layer of sutures by means of the Cushing rectangular suture. (Harrington's operation. Charles H. Mayo, *Ann. Surg.*, 1908, xlviii, 105.)

operation, because it affords more room and makes the parts more accessible, is taken away.

In the female bladder we have an organ peculiarly favorably placed for extensive operations and for subsequent protection from the dissemination of

any infectious materials by the suturing of the round ligaments and the uterus across the lower abdomen from side to side, completely sequestering the anterior portion of the pelvis from the rest of the abdomen.

Treatment of Carcinoma.—The methods of treating a carcinoma of the bladder are:

- (1) To let all advanced cases alone, except for the establishment of a permanent vaginal or suprapubic drain to relieve symptoms.
- (2) To extirpate the disease by a wide resection of the bladder wall;
- (3) To extirpate the bladder completely with implantation of the ureters elsewhere.

1. The best that can be done where the disease is widespread is to wash the organ out repeatedly with a warm 1-2 per cent. carbolic acid solution or permanganate of potash 1-1,000, or a simple boric acid solution. If the patient suffers much strangury one can then inject novocain (2 per cent.) into the septum, and, beginning with the external urethral orifice, divide, first the urethro-vaginal and then the vesico-vaginal septum, making a common cloaca of vagina and bladder.

2. In extirpating the disease by resecting the bladder, several methods must be considered: operation by the vagina, a transperitoneal operation, or a suprapubic extraperitoneal one.

In a carcinoma at the base of the bladder in a multipara, where there is but little infiltration, a satisfactory exposure can be obtained by making an inverted T-shaped incision through the anterior vaginal wall followed by the dissection of the vagina from the bladder on all sides, as well as the dissection of the bladder from the cervix of the uterus, as in a cystocele operation. The operator may, if necessary, open the peritoneum widely to facilitate pulling the bladder down, when it can be resected on all sides. A preliminary catheterization of both ureters will make it safer and reassure the operator when he is passing the sutures. The resected bladder can be closed with two layers of running sutures of fine chromic gut and the vaginal wall closed as in an extensive fistula operation.

In making an extraperitoneal suprapubic operation, the mode of access to the bladder is the same as outlined under papilloma. The resection of the bladder is in all respects like the same operation for an ulcerated area described under the operative treatment of cystitis, only the incisions ought to be made two cm. wide of the diseased area and carried boldly through all the coats of the bladder.

The preliminary cystoscopic examination has showed where the growth is located. This determines to some extent the direction of the incision into the

vertex to expose the neoplasm. A preliminary disinfection of the diseased area, as soon as exposed, with absolute alcohol, is a good plan. The incision ought to be made so as to circumscribe a superior lateral or posterior growth by the simple continuation of the opening above. This avoids lines of incision crossing each other or joining at obtuse angles.

When a ureter is involved, it must be boldly dissected out and reimplanted in the posterior portion of the bladder. Any actively bleeding vessels should be clamped during the excision and then tied with catgut. If the operation has been long and trying for the patient, and the operator wants to close up as rapidly as possible, he will probably elect to use interrupted chromic catgut sutures, including all layers. A more leisurely and perfect closure will be made by using a continuous suture, the separate points passed about 3 mm. apart.

If the tissue surrounding a tumor at the base has been exposed to infection during the enucleation, a stab wound into the vagina and a small drain will take care of it. In most cases a liberal suprapubic drain must be provided to facilitate cleansing the bladder during the healing process. Such a case should always remain under the surgeon's observation; if there is recurrence, the only possible hope lies in a massive dose of radium best given by a suprapubic opening.

3. Total extirpation of the bladder.—When the malignant disease is too extensive to permit a resection of the bladder, and yet has not apparently extended beyond it, then the proposition may be made to a patient anxious to prolong life to submit to a total extirpation of the bladder.

Watson ("Genito-Urinary Diseases," Watson and Cunningham, 1908, i, 520) collected 38 cases, from the first by Bardenheuer in 1887 to one by Garré in 1907, which he tabulates. Of these, 19 died from the operation, one lived 15 years, and another 6 years.

It is Watson's preference to do a preliminary nephrotomy to settle the question of renal drainage before the extirpation. Others have implanted the ureters into the loin. Bardenheuer simply cut off the ureters and left them in the wound below. Pawlik implanted the ureters, as a preliminary step, into the vagina, which he subsequently converted into a urinary reservoir by adapting the amputated urethra to its orifice. Others have turned the ureters into the rectum. We think in a woman the best plan, after deciding how to deal with the ureters, is to inject pure alcohol into the bladder and to leave it there to sterilize it in case it is opened. The effort should be made, however, to complete the extirpation without cutting into the bladder until it is amputated in its urethral portion. Then open the abdomen by the usual incision and incise

the peritoneum from one round lip to the other, beginning afterward to detach the bladder from the uterus and the vagina as far downward and forward as possible in the median line. Stripping up the bladder at the sides, the tissues tend to gather themselves into a bundle at each lateral angle where the vesical vessels are found. These are ligated in a mass and detached, and the bladder pulled forward and upward, until at last it adheres only by its urethral portion, which is doubly clamped and divided, completely freeing the organ. Now sterilize the end of the urethra and invert it on itself with a suture. A drainage opening in the vagina will take care of secretions. The uterus and round lip can be stitched to the anterior abdominal wall, so as to sequester the field of operation from the abdominal cavity at large.

CHAPTER XXXVIII.

NEUROSES OF THE BLADDER.

Under this blanket name are grouped many functional disturbances of the bladder independent of visible organic alteration and presumably arising from pathologic changes in or stimulations of the nerves and centers in cord and brain which control the action of the bladder. These functional abnormalities may concern the sensory nerves or the motor nerves or both. They are quite common with many of the organic diseases of the bladder. Among the sensory disturbances are pain, both independent of and during the act of micturition, and increased or decreased impulse to empty the bladder in micturition. Among the motor disturbances are incontinence of urine, true or paradoxical, and retention of urine, partial or complete.

Information as to the nature and cause of many of these disturbances is still greatly wanting, in spite of the fact that nearly all of the conditions have been recognized and described since the very beginning of medical literature. Under chapter headings can be found each year in the "*Jahresbericht ueber die Fortschritte auf dem Gebiete der Geburtshilfe und Gynäkologie*," a long list of references to literature which is more or less valuable. One of the best general considerations is that of v. Frankl-Hochwart, "*Handbuch der Urologie*," Frisch und Zuckerkandl, 1905, ii, 777-871.

Pathology.—The pathology of the condition is imperfectly understood. Many of the graver diseases of the spinal cord, notably tabes, syringomyelia, and multiple sclerosis, often occasion the vesical symptoms under consideration. They are met with, likewise, in paresis, brain tumor, idiocy, and other troubles of the cerebrum. It is often difficult in these pathologic conditions of the nervous system to determine whether the vesical symptoms are directly due to them or whether they cause trophic and other disturbances of the bladder, with resultant gross anatomical lesions of the organ, and these latter give rise to the symptoms.

In addition to the organic diseases of the spinal cord and brain and injuries of these structures, there are many cases associated with neurasthenia, hysteria, and epilepsy and some independent of any recognizable cause. The sensory

disturbances are frequently dependent on some disease of the bladder which has disappeared but left an impress on the nerves of the mucous membrane. Of all causes gonorrhea is undoubtedly the most frequent, in both the female and the male. Frequency of voiding, pollakiuria, retentions of a non-mechanical nature, and incontinence are often dependent upon psychical influences. This is particularly true of the enuresis of childhood.

Diagnosis.—In the diagnosis of a functional disturbance in contradistinction to an organic disease, it is most important that a complete and most careful exclusion of the latter be made. This is accomplished by complete systematic urological, and finally general examination. It should be remembered in this connection that the bladder is one of the most sensitive organs to reflex influence in the entire body. Small lesions about the rectum often completely upset the normal physiologic activity of the bladder, as is frequently observed after operation for hemorrhoids or treatment of a fistula. In some cases in children hypertrophied tonsils and adenoids which interfere with breathing seem to be the causes of enuresis. Various diseases of the sexual organs, such as phimosis, adherent clitoris, etc., frequently occasion the trouble.

It is most important, as a preliminary to the present consideration, for the reader to carefully review the facts of the normal physiology of the bladder, which are given in Chapter V. For the sake of convenience, we propose to treat the condition under the headings of Sensory Disturbances, Incontinence, Retention, and Enuresis, briefly referring to the general facts in tabes, paresis, neurasthenia, and hysteria.

SENSORY DISTURBANCES.

The sensory disturbances of the bladder are those of pain and those connected with changes in the impulse to empty the bladder.

Pain in the bladder, so common in organic diseases, notably cystitis, is comparatively rare where there is no disease of the organ. In tabes there are patients who have crises of pain referable to the bladder. So many tabetic bladders, however, show organic lesions that it is difficult to tell whether the pain is primarily due to the spinal disease or to the secondary bladder lesions. Not infrequently in the female disturbance in the bladder is met with in association with disease of the internal genital organs. We see every year several patients whose sole complaint is discomfort and pain in the bladder, usually aggravated on micturition, but without pollakiuria and with no demonstrable lesions of either the bladder or the nervous system. The pain in some of these

cases is very great, in others merely an annoyance, described as a dull ache. Occasionally an arthritis of the spinal vertebræ can be demonstrated by a skia-gram. Many of these patients have had a history of gonorrheal infection. The treatment is generally most unsatisfactory. Strong applications through the cystoscope, such as 10 per cent. silver nitrate, to the trigonum afford temporary relief, but rarely anything permanent. We have some patients who come in for these applications every two or three weeks and continue them for years. Both the faradic and galvanic currents, as well as diathermie, are occasionally of benefit. The application of hot water bags at night may aid the sufferer in securing much-needed rest. Occasional success with the X-ray is reported. Our own experience with this, as well as with radium radiation, has not been encouraging. In some cases which have persisted for years there ultimately results spontaneous improvement. It should be remembered that the trouble, usually seen in a neuropathic person, tends to produce marked mental depression. One case of our own, a most excellent woman, after complete failure to secure relief, having had the trouble several years, committed suicide.

A much more frequent disturbance is that where the impulse to void is more acute and the number of micturitions consequently increased. The name pollakiuria was applied to this condition by Dieulafoy. Normally, the frequency of micturition varies greatly with heredity, habit, social convenience, age, and sex. Children void more frequently than adults, and men oftener than women. Voiding is more frequent by day than by night. More than seven micturitions in the twenty-four hours should be considered abnormal in an adult. It is necessary to separate carefully the cases of true pollakiuria from those dependent on polyuria. V. Frankl-Hochwart (*loc. cit.*) mentions the case of a child troubled in this way who had been for several years in an orphans' asylum. It was found that a well-meaning attendant had insisted on the little fellow drinking enormous quantities of water; changing this habit cured the trouble. In all such cases it must be carefully determined that there is no diabetes, diabetes insipidus, or chronic interstitial nephritis. In some patients the frequency is the only symptom. In many there are burning and pain in the act of voiding. This latter condition has been given the name "irritable bladder." The condition is dependent as a rule upon abnormal sensibility of the nerves of the bladder either at their ending or at some point in their course. With this anatomical basis a number of conditions bring about the disturbance which would not cause it in a healthy adult. It seems that in adult women and men the commonest single cause for the condition is gonorrhea, which has healed but left this miserable reminder of its former presence. There are, however, many cases in which there is no evidence whatever of there having been such an infec-

tion, or any infection whatsoever. Many healed tuberculous bladders present the same tendency. With these patients very slight alterations in the acidity of the urine are enough to excite trouble. Disturbances in remote organs—for example, in exophthalmic goiter—cause the condition. It is also a very common reflex from diseases of the rectum, hemorrhoids, fissure, etc., as well as from the genital organs. It is often the initial symptom of tabes, of general paresis, and of other degenerative diseases of the central nervous system. As a purely psychic disturbance it is most common both in those definitely insane and those classed as psychasthenics and neurasthenics. The majority of this class of patients are more troubled by day than by night, and under excitement than when quiet. Many of them have associated fixed ideas which bring on the impulse to void. Many patients cannot pass a urinal or hear running water without voiding, and are usually made worse by the thought that they are under some constraint or necessity which prevents their attending to the urgency. Paget quotes the case of a minister who regularly catheterized himself before his sermon in order to be sure that the bladder was entirely empty; failing to do this, he invariably had to interrupt the discourse. Such patients are almost always melancholic and have their minds constantly on their trouble. A variance from this frequency of voiding is met with in those cases in which there is difficulty in starting to void with cramping pains and inability to empty freely the last few c.c. These little troubles assume enormous proportions in the minds of the patients. When a patient presents himself to the physician, or when a little child is brought in by his parents, it is evident that most careful consideration should be given the condition. A searching urological examination is absolutely necessary. General diseases such as diabetes, exophthalmic goiter, etc., must be excluded; the rectum, the throat, the genital organs, and all other places where reflex irritations might start must be investigated. Not less important is a careful consideration of the patient's habits, social conditions, and mentality.

Treatment.—The treatment is largely dependent on the cause. Where the central nervous system is involved, the treatment should be directed toward this. Any small local disturbance which is causing irritation in any part of the body should be attended to; this is especially true of rectal fistulæ and fissures. The habits should be regulated so that the urine is kept bland; that is, water should be taken in moderation, acids avoided, and some mild alkali-producer like potassium citrate given. It is rare in cases of pollakiuria to find any alteration in the bladder capacity by fluid measurement. As a rule, the urethra and the bladder are quite sensitive. We have had little or no benefit, in most cases, either from dilatation of the bladder or of the urethra. In those

cases which depend on an old gonorrheal infection benefit is sometimes obtained by applying 10 per cent. silver nitrate to the urethral and trigonal areas. We have a patient now under observation where this condition is present, and where there is relief for a week after each application. If there is a little granulation or polyp in the urethra, its removal, coupled with complete assurance of cure, is of help, as we have proven in several cases. Great care should be exercised, however, in promising relief, as in most cases it will not come and disappointment renders the patient worse. As a rule, local treatments should not be employed; they tend to focus the patient's already too concentrated attention upon the disease. The patients react well, as a rule, to suggestion and thorough psychic control. We have one patient who stayed well for several months simply from having a special corset fitted upon her with the assurance that it would give her the desired effect. Sad to say, however, only too many of these unfortunates show recurrences.

INCONTINENCE OF URINE.

Under the headings of Urinary Fistula and Abnormalities of the Urinary Organs in other sections of this work the conditions of traumatism or maldevelopment which lead to incontinence of the urine are dealt with. Here we are dealing with incontinence due to improper functioning of the bladder. True incontinence is a condition in which the bladder no longer acts as a reservoir but allows the urine to flow continuously out of it; false incontinence, the so-called paradoxical incontinence, is due to the overdistended bladder allowing the urine to dribble continuously from it. This is the condition commonly met with in injuries of the spinal cord, sometimes in tabes and in enlarged prostate.

For practical convenience in presenting the matter, it is well to separate incontinence in adults from that in children, which we will consider under the heading Enuresis.

There are two distinct types of true incontinence; the first, which is quite rare except in adult females who have birth injuries, is dependent on a complete lack of tonicity in the sphincter muscle of the bladder—the urine simply running through; in the second the urine accumulates but is involuntarily passed and the bladder completely emptied—this simulates normal urination in every way except that it is not under the control of the will. The gross diseases of the central nervous system, which lead to incontinence, are transverse myelitis, Pott's disease, tabes, and paresis. The trouble is also frequently

met with in hysterics and psychasthenics. The diagnosis rests on a careful local and general examination.

When there is reason to believe there is incontinence due to prolapse of the bladder wall or lack of tonicity of the sphincter, an operation is indicated. The ordinary anterior colporrhaphy is not efficient. Many operative procedures, such as those of Pawlik and Duret, which consist in narrowing the urethra, either in its whole length or its external meatus, or that of Gersuny, which is essentially a torsion of the urethra through an angle of 180° , or that of Albarán, which transplants the urethra up near the clitoris, are useful. An invariably satisfactory procedure is that which consists in a suturing of the sphincter vesicæ; it can either be combined with anterior colporrhaphy or done alone. This procedure, which has been used by one of us (Kelly) for a number of years, and with great success, was reported by him in the *Urologic and Cutaneous Review*, 1913, xvii, 1. We quote this report in full:

"There is a peculiar form of incontinence of urine in women which either follows childbirth or comes on about middle age, and is not associated with any visible lesion of the urinary tract. Sometimes the most suggestive picture that can be seen by cystoscope is a gaping internal sphincter orifice which closes sluggishly. In the incontinence which comes on at about 40 years or over the patient usually first notices the occasional escape of a few drops of urine as she makes some unusual exertion. This grows worse until, at last, a little urine runs out whenever she coughs, laughs, sneezes, lifts anything, or steps up high. The condition may finally become so bad that the underclothes are constantly wet and soiled with the malodorous secretions.

"For a long time surgeons have tried to relieve this condition by a variety of operations, some of them more or less bizarre, designed to act upon the external urethral orifice by contracting it, or to resect the vagina at the internal orifice, or to kink the urethra, or in one way or another to compress it. These operations rarely succeed. I have seen many patients subjected to them, but none relieved.

"The key to successful treatment lies at the internal orifice of the urethra and in the sphincter muscle which controls the canal at this point. For the past 10 or 12 years I have been operating constantly upon patients suffering from this minor distressing inconvenience and I have succeeded in relieving every case where there had not been a destruction of the tissues at the urethral orifice, that is, where there had been no vesicovaginal fistula with sloughing.

"The operation which I do is as follows: A Pezzer catheter is introduced into the urethra; the tube ought to be small, not over 5 mm. in diameter. With the patient in the lithotomy position, the posterior wall of the vagina is re-

tracted and the area at the neck of the bladder is brought down with either forceps or four guy sutures.

"The next step is to slit the vaginal wall down to the urethra and the bladder in the median line for about $1\frac{1}{2}$ or 2 inches. The neck of the bladder should fall at about the center of the incision. The position of the neck is easily determined at all times by moving the catheter to and fro, and feeling its head, which presses close up against the urethra. The utmost care should be taken not to cut into the urethra or the bladder at any step of the operation. After making this median incision the vagina is further dissected off on both sides with tissue forceps and dissected away for a distance of 2 to $2\frac{1}{2}$ cm. around the neck of the bladder. This dissection may be made with blunt pointed scissors which push their way into the tissues, separate the bladder from the vaginal walls, and then cut the connecting fibrils. The dissection should be deepest at the neck of the bladder.

"When the detachment of the vagina from the bladder is completed, the finger should be able to grasp at least one-half or two-thirds of the neck of the bladder, including the contiguous urethra. Sometimes the bladder wall is so thin that its mucosa shines through.

"The next step is to suture together the torn or relaxed tissues at the neck of the bladder, using 2 or 3 mattress sutures of fine silk or linen passed from side to side. The first suture, taking in about $1\frac{1}{2}$ cm. of tissue, is tied at once, when the succeeding suture may be passed outside this, further contracting and bringing together the tissues at the neck. This is the principal part of the operation, and when done the mushroom catheter ought to be pulled out, the head of the catheter escaping with a little jump as it clears the tightened reconstructed sphincter at the neck of the bladder. The more or less redundant vaginal walls, which have been detached in order to expose the sphincter area, are now resected so that the remaining tissues can be snugly brought together from side to side, so as to support the vesical area operated upon and avoid any dead space between bladder and vagina. I prefer to do this suturing with a continuous fine catgut suture in one or two layers.

"The after-treatment is simple: No catheterization unless imperative, though sometimes it must be done for several days or even for a week. A Gatch bed and a half-way-up posture from the very first, and then out of bed in a few days."

In addition to this operative procedure, the paraffin injection of Gersuny has been recommended. We use this in a number of patients and occasionally with good result. It sometimes gives trouble immediately after injection and

often becomes lumpy and has to be removed. The principle is to inject paraffin, which melts at 41° C., by means of a large glass syringe.

Occasionally satisfactory results are obtainable by faradic stimulation of the sphincter of the bladder. A rather interesting case of this kind occurred in our practice where the incontinence followed an extensive removal of the urethra for carcinoma. A complete incontinence of several months was cured and has remained cured now for 8 years.

In those patients where the incontinence is of a hysterical or psychic character the best results are obtained through psychic treatment. These patients invariably dwell upon their condition and imagine that it is causing or being caused by some serious trouble. Excellent results are obtained through suggestion, through psychic control, and even through hypnotism. In one of our own cases a Miss M., 19 years old, there had been for several years wetting of the bed by night and passing of urine involuntarily by day. This occasioned her the greatest discomfort and humiliation. In her case, after a thorough examination, complete cure resulted from suggesting to her that she was being hypnotized, and that it would be impossible for her, even if she wanted to, to again commit this fault. Trömmner (*München. med. Wchnschr.*, 1912, lix, 1465) reports the healing of one-third of his cases in children by this method. Where the general practitioner fails to secure results he should at once turn the patient over to an expert in psycho-analysis and psychic treatment.

ENURESIS.

Incontinence in children is often spoken of as an enuresis. It is commoner in boys than in girls, although Trömmner (*loc. cit.*) in 173 cases found 73 in females. It is usually nocturnal, occurring only once or twice a week, or every night. During the day the children usually suffer from pollakiuria. As a rule, they sleep very deeply and are not awakened by the accident. Heredity plays an important part. T. K. Monro (*Lancet*, 1896, i, 704) observed a father, 5 daughters, and 1 son, who all suffered with this disturbance. Many of the children have hereditary neuropathic tendencies. There may be diminished sensibility of the bladder and often of other parts of the body. It occurs, however, frequently enough in perfectly healthy children. As a rule, it will stop after the seventh or eighth year, but sometimes persists until puberty, and occasionally after it. Janet has drawn attention to how completely the minds of these little children revolve about their peculiarity so that the consciousness of it is with them day and night. As a rule, the bladder is com-

pletely emptied. Civiale ("Traité des maladies des organes génito-urinaires," iii, 40) reports a case in a child where there was more or less continuous distention of the bladder.

The treatment is varied according to the individual case. One should employ the psychic methods used in the adult. Great care should be exercised, however, not to chastise the child, or make it dread its condition, or be excessively ashamed of it, as this simply makes it worse. During the day the child should learn to empty its bladder regularly at given intervals. Suggestion as the child is going to sleep is of value. The amount of fluid which it takes immediately before bedtime should be carefully regulated. Among medicinal preparations strychnin and atropin in full doses have long enjoyed an excellent reputation. The atropin is best given as extract of belladonna. Fritsch (*Dtsch. med. Wchnschr.*, 1911, xxxvii, 1266) has secured favorable results with yohimbin, giving from one to three tablets a day. N. Serrallach (*Cong. de l'Assoc. internat. d'urol.*, Par., 1908, 365) has cured some cases by the injection of a testicular extract. Massage of the lumbar region, and of the hypogastric region of the neck of the bladder, as well as the application of electricity to these regions have been employed, but with indifferent results.

A widely employed and frequently successful treatment for enuresis is that of Cathelin (*Thèse de Paris*, 1903). This author and Albarran observed accidentally that an injection of cocain into the epidural tissues surrounding the cauda equina relieved a woman suffering with grave incontinence of the urine. From this fortuitous observation was developed the now well-known treatment. The technique is to put the patient in Sims' lateral posture, to locate the coccygeal spine, to introduce a lumbar puncture needle in the middle of the line joining the coccygeal cornua, and pass it directly upward. The meninges should not be perforated. From 5 to 25 c. c. of normal saline solution at body temperature are then slowly injected. This procedure is almost painless, and after it the child can be sent home; if necessary, the treatment is repeated within 10 days. About 80 per cent. of the cases are cured. Recently excellent results have been reported by R. Ch. M. Curet (*Thèse de Bordeaux*, 1910-11, No. 18) and also by Mellow Leitao (*Brit. J. Children's Diseases*, 1912, ix, 106).

A somewhat different technique is that of Jaboulay, reported by Revel (*Thèse de Lyon*, 1904). His plan is to introduce the needle between the coccyx and the rectum, and to inject from 100 to 200 c. c. of normal saline solution. This method has been much less employed, and is more painful, but it seems also to give results in many cases.

RETENTION OF URINE.

Retention of urine occurs most commonly as a result of mechanical obstructions, due, in the male, to enlarged prostate; in the female, to pelvic tumors and procidentia. With this class of retentions, however, we have nothing to do in this chapter. Retention may be complete or incomplete, acute or chronic, temporary or permanent. It is rare in brain diseases, occurring principally in apoplexy and imbecility. It occurs invariably in injuries to the spinal cord. It is one of the earliest and most significant symptoms of tabes. In this condition the bladder loses its sensibility and it becomes more and more difficult for the patient to empty it. Usually there develops a well-known paradoxical incontinence. It is not an uncommon accompaniment of acute surgical abdominal conditions, as well as of many acute infectious diseases. Poisons, such as phosphorus, mercury, and arsenic, may be the inciting cause. Its occurrence after operation, particularly operation upon the pelvic organs or rectum, is one of the bugbears of the surgeon. Some of these post-operative cases may persist, requiring catheterization for weeks. The condition has been explained by two different mechanisms, both of which probably play a part: the first is cramp of the sphincter muscles; the second inhibition of the motor nerves to the detrusor muscle. The latter is undoubtedly the commoner cause in most of the cases of persistent retention.

In the chronic retentions there result the distentions of the bladder, ureters, and pelves of the kidneys so well marked in prostatic hypertrophy. Infections easily develop and lead to most serious results. In acute retentions, if properly relieved, there is usually no pathologic change.

A most interesting group of chronic retentions occurs in hysterical patients. Sometimes the trouble starts from an acute cause, such as an operation, sometimes it seems to arise without any cause. We have observed several such cases in women. These retentions may last for months, requiring constant use of the catheter, and then may disappear in the twinkling of an eye. Often the cure is temporary and the disease recurs. With most of these patients there are marked general hysterical manifestations. They usually accumulate large quantities in the bladder and have a great deal of pain until catheterized. The trouble seems to be one of inhibition of the detrusor nerves. In 2 cases, one a girl of 18 and another a woman of 40, the sphincter was found quite lax and with the catheter in the bladder the urine could not be forced out to a plane above the level of the bladder. In both of these patients almost every conceivable irritant, such as heat, hot water and chemical irritants, failed to relieve. After

weeks of treatment they suddenly and spontaneously got well. Operations occasionally relieve, but should be undertaken with great circumspection, as they may do further psychic harm. Good results have been reported from hypnotic suggestion.

The diagnosis rests on catheterization, which excludes anuria. Careful urologic examination must be made to exclude mechanical causes, and gross lesions of the nervous system must be examined for, especially tabes.

The treatment of acute retention should be the application of hot pads to the perineum, hot Sitz baths, hot rectal injections, the removal, by psychic means, as far as possible, of all anxiety, and, in operative cases, where possible, having the patient sit up or stand up. When these measures fail, catheterization must be carried out. In the more chronic cases beneficial results are sometimes obtained through the use of thyroid extract. See Firth (*Lancet*, 1911, ii, 1619); Fleischner (*Cal. State J. Med.*, 1911, ix, 67); Ott and Scott (*Month. Cycl. and Med. Bull.*, Phila., 1911, iv, 420). In addition to thyroid extract, pituitrin is occasionally of benefit. R. Hofstätter (*Wien. klin. Wchnschr.*, 1911, xxiv, 1702) advises its use and reports interesting observations. Waldstein (*Gyn. Rundschau*, 1911, v, 525) states that 90 per cent. of the cases are relieved by urethro-injections of 90 per cent. glycerin mixed with 9 per cent. neutral soap. Yohimbin also is effectual in some cases. The best results are secured through psychic means, restoring the confidence of the patient in the belief that the bladder is still capable of emptying itself.

CHAPTER XXXIX.

MALFORMATIONS OF THE URETHRA.

Urethral anomalies are rare. They are:

- (1) Absence of the urethra.
- (2) Double urethra.
- (3) Hypospadias.
- (4) Epispadias.

1. ABSENCE OF THE URETHRA.

If the urethra is completely absent, the bladder and the vagina end in a cloaca possessing a common vestibular orifice below (persistent urogenital sinus).

2. DOUBLE URETHRA.

But few cases of double urethra are known. The canal may be doubled throughout, or it may be forked in front to present two external orifices, lying either one in front of the other or side by side.

Fuerst (*Arch. f. Gyn.*, 1876, x, 167) figures a case in which the urethra appears normal looked at from its vesical orifice, but 0.3 cm. down the canal there is a thin septum which increases in thickness until two urethral orifices appear side by side in the vagina, separated by a fleshy partition.

Stretton observed a case in a child 19 months old, in which one urethral orifice was close beneath the clitoris, while another lay $\frac{3}{4}$ in. behind it. Catheters introduced into the orifices touched, and urine escaped from both at the same time.

The treatment of a double urethra is called for in case of incontinence, when the shorter or more defective canal should be dissected out and the wound closed with extreme care to secure primary union.

3. HYPOSPADIAS OR VAGINAL URETHRA.

Here the external orifice of the urethra lies at some point on the anterior vaginal wall within the hymen. A hypospadias represents an arrest of the development of the vesico-vaginal septum in the third month of intra-uterine life. At this time the clitoris is relatively large, and it is impossible to distinguish sex from the external genitalia alone.

Bolk (Ref. in *Gyn. Rundschau*, 1908, ii, 457) declares that the female urethra is formed of 2 parts: an upper, taken from the tissues designed to form bladder and urethra; a lower, derived from the primitive urogenital sinus. These two grow together, while at the same time folds grow in from the lateral walls of the sinus and unite to form the lower urethra. Any disturbance of the union of these folds produces hypospadias.

Blum (*Monatsb. f. Urol.*, 1904, ix, 522), after a careful study of 35 cases collected from the literature, divides them into 3 classes:

(a) The urethra is completely divided and there is a slit-like communication between the bladder and the vagina (11 cases).

(b) The vagina, imperfectly developed, ends in the urethra (persistent urogenital sinus) (14 cases).

(c) The urethra ends above in the vagina (10 cases).

Inasmuch as the clitoris is relatively large at the time the arrest of development takes place, the persistence of this stage of development accounts for the pseudo-masculine type of the hypospadiacs, many of whom have a large, developed clitoris, with a well-defined gutter running back toward the urethral orifice. Sometimes, also, the labia majora resemble the scrotum, and occasionally the vagina is double, both perpetuations of a male type.

Symptoms.—In the deformities of lesser degree the patient suffers no inconvenience; in those of higher grade there is incontinence from birth, or it may first appear to a marked degree after coitus or after childbirth. The discovery of the condition is naturally not often made until the child is old enough to be expected to retain her urine for some hours. Sometimes a hypospadias gives rise to retention of urine of a high degree. Blum explains this by the fact that the short defective urethra may turn at an angle down into the vagina instead of running horizontally like a normal urethra. Here, as the bladder fills, the retention becomes more and more difficult to overcome.

Treatment.—None is called for in the milder conditions. In the higher grade, a urethra is formed by splitting flaps on both sides and making lateral incisions to set them free, followed by a careful approximation of the wounded

FIG. 610.—DURAND'S CLASSIFICATION OF THE VARIOUS FORMS OF EPISPADIAS. Fig. 1. Sagittal section of a normal vulva. Fig. 2. Epispadias of the least degree involving the clitoris, the urethra opening above its level. Fig. 3. Sub-symphyseal epispadias. The anterior wall of the outer portion of the urethra is wanting, involving about half the urethra. Fig. 4. Total or retro-symphyseal epispadias. The defect extends all the way up to the bladder; the sphincter is, however, intact. The entire posterior wall of the urethra is present. Fig. 5. Sub-symphyseal exstrophy. The neck of the bladder is involved but the symphysis is present. This form of exstrophy is likely to be confused with epispadias of a high grade. Fig. 6. The common form of exstrophy of the bladder associated with a diastasis of the symphysis. 1, urethra; 2, clitoris; 3, bladder; 4, symphysis; 5, inner surface of labium minus; 6, labium majus; 7, sphincter muscles at neck of bladder.



3

1

Fi

---o

1

2

Fig 3

Fig 4

2

1

Fig 5 A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z.

Fig 6

A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z.

surfaces with fine chromic gut suture so as to form a urethra over a small catheter, say 5 to 6 mm. in diameter. An attempt should be made to form a sphincter of the bladder by liberating the tissues at the neck of the bladder, preferably using non-absorbable suture. A complete recovery is reported by Mackenrodt (*Centralbl. f. Gyn.*, 1905, xxix, 554) in a case of a girl 21 years of age.

4. EPISPADIAS.

In epispadias the anterior urethral wall is defective and the clitoris is divided, a smooth furrow extending up between the labia majora. The accompanying diagram from M. Durand (*Ann. de gynéc.*, 1895, xliv, 14) shows the various forms of epispadias as contrasted, on the one hand with the normal relations of the parts, and, on the other, with superior fissure of the bladder and with a separation of the symphysis and exstrophy (Fig. 610).

Three forms of epispadias are to be distinguished: the clitoridal (Fig. 610 [2]), where the clitoris is divided into halves and the opening of the urethra appears just above it; the symphyseal (Fig. 610 [3]), in which there is a larger defect, the urethra opening directly under the symphysis; and the retrosymphyseal, where the defect takes in the whole anterior wall of the urethra, but the neck of the bladder is not involved (Fig. 610 [4]). When the vesical sphincter, too, is defective and split, and there is no true internal urethral orifice, the condition is known as inferior fissure of the bladder (Fig. 610 [5]). The distinction between these last two conditions is sometimes more theoretical than demonstrable.

Before Durand's time, in spite of numerous reported cases in French and German literature, there had been a lively discussion whether epispadias really occurred in the female, and most cases of it were credited to the account of inferior fissure of the bladder. Even so excellent an authority as von Winckel, as late as 1885, denied the occurrence of epispadias. Durand cleared the subject of discussion by distinguishing between the cases in which the anterior wall of the bladder was involved and the fissure cases including the neck of the bladder.

An exstrophy does not demand treatment unless the patient suffers from incontinence. Relief has been afforded by a broad denudation of both sides of the urethra above and at the sides, followed by careful suturing, preferably using buried sutures of fine chromic catgut. The accompanying figures (Fig. 611) are taken from a case of R. Frommel's (*Ztschr. f. Geburtsh. u. Gynäk.*, 1882, vii, 430). The urethra was here only $\frac{1}{4}$ cm. in length. A double tri-

FIG. 611.—FROMMEL'S CASE OF EPISPADIAS IN A WOMAN 26 YEARS OF AGE. The upper figure shows the condition of the patient. The lower figure shows the result secured by operation. c, clitoris; U, urethral opening; L. min., labium minus; L. m., labium majus. (*Ztschr. f. Geb. u. Gyn.*, 1882, vii, 430.)

FIG. 612.—STILES' METHOD OF IMPLANTATION OF THE URETER IN EPISPADIAS. The ureter is exposed at the brim of the pelvis and freed as far as the base of the broad ligament, where it is ligated and divided just above the ligature. The mucous membrane of the anti-mesenteric aspect of the lowest portion of the pelvic colon is now exposed by a transverse incision about a quarter of an inch in length and shut off with forceps and carefully isolated. The mucous membrane is then pulled up, in the form of a tiny diverticulum, and clipped off, making a small opening into the bowel. The end of the ureter is drawn through the opening and fixed within the lumen of the vessel by means of the fixation suture. The ureter is then fixed in its relation to the bowel and covered, as shown. (H. J. Stiles, *Surg., Gyn. and Obst.*, 1911, xiii, 127.)

angular denudation was made at both sides, and with its apex at the mons veneris. The tissues were then united with fine sutures passed from side to side by means of small needles. In this way from 1½ to 2 cm. was added to the length of the urethra. The patient was able to control her urine from the first, and at the last report could retain it for 4 hours.

H. Rasch (*Beitr. z. klin. Chir.*, 1897, xviii, 557) operated on a girl 21 years old with a splendid result, by making a denudation in the form of an inverted horseshoe above the urethral opening and in front of the symphysis. The ends of the denudation rested on the halves of the clitoris. The flap thus made was turned down and dissected loose until the neck of the bladder was exposed. Three sutures were passed here to draw the fibers of the sphincter closer together. The urethral tissues were then united from side to side with silk sutures. This procedure closed the hiatus above. The course of the healing in this case was rapid and uninterrupted. The sutures were removed at the end of 6 days. The child was exhibited at the Medical Congress in Prague as having perfect control of the urethra.

Harold J. Stiles (*Surg. Gyn. and Obst.*, 1911, xiii, 127) reports 2 cases of treatment in which there was success: the first was in a little girl of 3 and the second in one of 4 years. The results obtained were very favorable.

The details of Stiles' operation (Fig. 612) are as follows: The ureters are transplanted into the lower part of the pelvic colon separately, at intervals of three to six weeks; the abdomen is opened. Near the outer border of the right rectus the peritoneum is packed off on either side of the ureter, at the level of the plane of the pelvis, a little below the termination of the common iliac artery. The ureter thus exposed is freed from the extraperitoneal cellular tissue from the plane of the pelvis to the base of the broad ligament. The ureter is then ligated well forward and divided just above the ligature, the upper end being clamped with a little spring forceps and a guiding suture passed through the upper end of the ureter. The lowest part of the pelvic colon is now pulled up into the wound, and a loop about 3 inches in length is made down to, but not run into, the mucous membrane. By snipping off the apex of a tiny diverticulum of mucous membrane a small opening is made into the bowel. The end of the ureter is drawn through the opening and fixed within the lumen of the bowel by means of the catgut fixation suture. The permanent fixation suture is now applied on the Witzel gastrostomy principle, by uniting 2 parallel folds of the intestinal wall over the inflamed ureter by means of a straight needle and a continuous fine linen suture. This folding-over process, commenced ¾ inch below the entrance of the ureter into the bowel, is continued for 1 inch above it. The upper portion of this suture, after packing off the sero-

muscular fold of one side, ought also to pack off a portion of the whole of the ureter without entering its lumen. In order to diminish the risk of strangulation it is important to see that the borders of the ureter, which pass from the opening left in the peritoneum to the site of the implantation, should be as short as possible. It is for this reason that the implantation is made as near the rectum as possible.

In a personal communication Mr. Stiles gives the results of his method as follows: "So far, I have done eight cases in children, some for epispadias in the female and others for extroversion of the bladder. Four have died, but the other four, I am pleased to say, have remained perfectly well, and they can retain their water in the bowel for from three to five hours. The first two cases were done seven years ago. The younger ones have to be lifted once during the night, the older ones can go the whole night without wetting the bed."

CHAPTER XL.

PROLAPSE OF THE URETHRAL MUCOSA.

Prolapse of the urethra is a rare affection, found most often at the extremes of life—either in young girls from infancy up to twelve years of age, or in women well over fifty or upward of seventy. L. Kleinwächter (*Ztschr. f. Geb. u. Gyn.*, 1891, xxii, 40) collected most of the cases known up to that time, mingling the young with the old and including in his list of 50 cases, 4 over 70 years of age and 9 in the middle period of life. B. Singer says that more than half the cases are found in children, 9 out of 44 being between the ages of 18 and 40.

PROLAPSE OF THE URETHRA IN ADULTS.

To speak first of the older class of patients, the prolapse appears to be an expression of senile involution associated with a thinning of the urethral tissues, while the urethra remains lax and large. A slight prolapse at the external orifice of the urethra, the form most commonly found, usually produces a congestion at the sharp edge of the introitus and this, associated with swelling and, it may be, edema, serves to pull out the tissues lying immediately above, so producing one of the common forms of prolapse and, it may be, a thrombosis due to constriction of the vessels (Figs. 613 and 614). This again produces gangrene and sloughing. Sometimes the gangrene affects chiefly the upper part of the urethra, so that we have another form, namely, inversion of the mucosa above, so that it appears at the external orifice and is extruded there. Patients with this trouble are not much distressed by it at first. Although urination may be more difficult and somewhat painful, associated with straining and from time to time with bleeding, and the tumor soon becomes apparent, the patient herself may be in the habit of slighting it, until at last, as it increases in size and is not easily repressed, she seeks the advice of her physician. When thrombosis has occurred, the appearance of the parts is so different that we shall give a separate description of this outcome of a prolapse.

A thrombosis of the veins of the prolapsed urethra is an end-result. The examination reveals a large, fleshy, glassy, edematous, or it may be a congested, dark red or violaceous tumor projecting from between the labia minora, apparently from the upper part of the vagina. The tumor is edematous, bleeds easily, and has been the source of a sero-sanguinolent weeping, necessitating the wearing of a napkin. Sometimes parts of the mass are necrotic and sloughing. It is not painful to touch. It is mushroom in form and the surface is depressed in the center, from which folds radiate toward the periphery. It is, as a rule, not difficult to catheterize, though this should be done

with care to avoid introducing infection into the bladder. The disease is usually limited to the parts at or near the external urethral orifice, and the recognition of its well-de-

FIG. 613.—A HIGH GRADE OF HYPERTROPHIED AND PROLAPSED URETHRAL MUCOUS MEMBRANE. (April 16, 1896.)

FIG. 614.—SAGITTAL VIEW OF CONDITION SHOWN IN LAST FIGURE. The urethra stands out like a broad-based mushroom projecting beyond the vagina with vaginal orifice beneath it. B is the bladder.

defined symmetrical shape and its localization serve to distinguish it from a malignant growth, which it most resembles. P. Mundé (*Amer. Jour. Obst.*, 1890, xxii, 615) describes such a case in a patient 75 years old.

The best plan of treatment is the radical surgical, namely, transfixing the tumor close to its base or beyond it, to keep it from inverting, and then trimming all the redundant mucosa off down

to the level of the external meatus. In doing this, numerous vessels are cut through, for the most part plugged with blood clots. A few actively bleeding

vessels may need tying with the finest catgut. The mucous membrane of the urethra is then sutured to that surrounding the meatus with a continuous, fine, interlocking catgut suture. The patient will do well to stay in bed from 5 to 7 days.

Pathology of Cause.—In a number of instances the cause of prolapse has been traced to an angioma of the mucosa at the urethral orifice. After removing the tumor, microscopic examination has shown that the epithelium is prac-

FIG. 615.—PROLAPSED AND STRANGULATED URETHRAL MUCOUS MEMBRANE. The tumor forms a bluish red and angry-looking swelling at the external urethral orifice. The appearance of the tumor simulated an inflamed strangulated hemorrhoid, to which it is in reality closely related, for on section, the tumor was found principally composed of greatly distended veins containing thrombi. (Mrs. H., May 5, 1908.)

tically normal, while beneath it there are the loose connective tissue and numerous thin-walled, dilated blood-vessels with coagula near them (Fig. 615).

Treatment.—The treatment of the form which is situated at the external urethral orifice is by excision of the redundant mucosa on all sides and a careful suturing to the margins of the external orifice (Fig. 616). It will be well, in order not to leave a gaping orifice, to make a little wedge-shaped excision of the vaginal tissues from the urethral orifice, extending 1 cm. up into the vagina, and by uniting the tissues from side to side, so narrow the urethral orifice as to assist in retaining the mucous membrane within.

In a case of inversion of the mucosa with prolapse, starting well above the external orifice, Kleinwächter split the urethra open on the right side to an extent of $2\frac{1}{2}$ cm.; then, pulling the tissues apart, the point of reflection of the inverted mucosa was seen, the prolapsing tissues cut away on all sides, the wounded surfaces united with fine sutures, and the urethra closed.

PROLAPSE OF THE URETHRA IN GIRLS.

Such prolapse forms a conical or cylindrical tumor, to the complete eversion of the lower part of the urethra, involving only the mucosa, analogous to prolapse of the rectum. The prolapse may be partial or complete. Partial prolapse may involve only the anterior part of the urethra or may consist in a prolapse and inversion of the upper parts of the urethra. Brüning (*Jahrb. f. Kinderheilk.*, 1911, lxxiv, 1-174) has studied this matter most carefully and had collected, up to 1911, 76 cases distributed according to age in the following manner:

manner:

1-4 years	.....	3	4 per cent.
5-7 "	.....	19	25 " "
8-11 "	.....	48	63 " "
12-15 "	.....	6	8 " "

In the earliest cases the affection dates back to the nursing period of life. The patient suffers from a burning pain, with frequent urination accompanied by straining and bleeding in 41 per cent. of the cases. An examination shows a red tumor of the vulva lying between the labia minora. There may be a bloody mucous discharge associated with it and dribbling of the urine; during the examination the urine may be discharged in a stream. There is often more or less vulvovaginitis. The size of the tumor is that of a hazelnut or a walnut and may vary from $\frac{3}{4}$ of a cm. to 4 cm. in length. The orifice of the urethra is sometimes difficult to find, and may lie over or to one side of the tumor.

Sometimes the opening into the urethra is large, almost large enough to introduce the finger. In less marked cases the appearance of the orifice is that of an ectropion.

Etiology.—The affection in no inconsiderable proportion of cases (11 in 76) develops suddenly. In other instances it is slow and progressive. Patients are often described as poorly nourished and feebly developed, bronchitis being

FIG. 616. — APPEARANCE AFTER CIRCULAR AMPUTATION OF PROLAPSED AND HYPERTROPHIED URETHRAL MUCOUS MEMBRANE SHOWN IN FIGURES 613 AND 614. The wound is closed from side to side, above and below, with interrupted fine catgut sutures. Then the remaining, central portion is united to the amputated urethral mucosa on the two sides.

noted and tuberculosis. On the other hand, some of the little patients are in excellent general condition.

The following causes are cited in the cases developed suddenly: a blow on the abdomen, lifting, rape, long-standing diarrhea, violent coughing. In 3 cases cited in Brüning's list the mother had likewise been affected. A catarrhal condition of the urethral mucosa is also found.

P. F. Mundé figures a case in a child 9 years old in the *Amer. Jour. Obst.*, 1890, xxiii, 616.

Diagnosis.—The mother is apt to think that the bloody discharge is due to a precocious menstruation. A physician once, mistaking a case for a polyp, recommended grasping it with forceps and twisting it off. A diagnosis was made by placing a catheter or uterine sound through the opening into the bladder. If the child is under an anesthetic and put in the knee-breast posture, the replacement will be effected more readily.

Treatment.—Some relief may be secured by putting the child at once to bed and applying lead water and laudanum to the parts. The best plan of treatment is a careful circular amputation of the prolapsed mucous membrane, sewing the outer and inner edges together on all sides after removal. It is a good plan to place 2 chromic gut sutures, at right angles to one another, at the base of the prolapsed mucosa, transfixing the entire prolapse. After amputation just outside the sutures, these are then cut and tied, so as to unite the tissues at 4 cardinal points, preventing anything like a reinversion.

CHAPTER XLI.

URETHRITIS.

Inflammation of the female urethra occurs in both an acute and chronic form. The acute urethritis presents marked symptoms and runs a rapid course, while the chronic may continue as the residuum of an acute form or develop slowly without any decided preliminary stage. We do not know of an acute urethritis which is not gonorrheal in character; the chronic form, however, may well be due to the infection of one or the other of the pathogenic organisms, such as colon bacillus, or staphylococcus, found in the urethra in at least 50 per cent. of all cases. Stoeckel earnestly insists that not all chronic cases are to be reckoned as gonorrheal in character.

ACUTE URETHRITIS.

The acute gonorrheal urethritis is accompanied by more or less severe and burning pain in micturition, frequency of urination, swelling of the urethral mucosa and eversion of the inflamed mucous membrane at the external orifice, often associated with a cystitis localized at least in the base of the bladder near the urethra, and with a vulvo-vaginitis, especially in a young girl. There is a more or less abundant discharge of pus from the orifice and Skene's glands are apt to be infected, exuding pus when pressure is made at the sides of the urethral orifice. The urethral mucosa is very sensitive to touch and bleeds readily. Sometimes there are linear ulcers found near the neck of the bladder. The treatment is always an expectant one, as the disease cannot rest long in its acute stage; therefore examinations and local applications must be foregone, as they do more harm than good. Patients should be encouraged to drink fluids abundantly and warm applications to the vulva should be used, with hot vaginal douches. Opium and belladonna rectal suppositories may be given at night to relieve the pain. During the treatment the patient ought, if possible, to stay in bed.

CHRONIC URETHRITIS.

The chronic form may persist as the residuum of an acute attack. At other times it comes on slowly, the common complaint being that of burning in micturition. This is especially marked if a small ulcer is left behind near the neck of the bladder. The disease is usually localized, especially at the upper

and the lower ends of the urethra and does not, as a rule, involve the entire organ. When the upper urethra is involved, the glands on the floor of the urethra become more marked and the mucosa more swollen and dark-red in color, while the blood vessels are congested and sometimes remarkably dilated, presenting an interesting urethroscopic picture. A short speculum (Fig. 617) is used for examination and treatment of the urethra.

10 mm

FIG. 617.—URETHRAL SPECULUM, IDENTICAL IN SHAPE WITH VESICAL SPECULUM BUT MUCH SHORTER. The usual size is shown in full with its obturator and large handle; it is 10 mm. in diameter; the ends of two smaller sizes are shown.

The swollen mucosa pouts into the lumen of the speculum, and the distended veins radiate out to the periphery central openings, as the speculum is slowly withdrawn after part of the urethra is inspected. As a rule, any slight manipulation of the inflamed mucosa produces a little hemorrhage. When the lower part of the urethra is involved, the speculum is almost withdrawn before the reddened mucosa pouts into its lumen. At one point or another, as the inflamed portion of the canal is passed, a little purulent secretion is forced into the speculum. This should be taken up on a loop of platinum, examined microscopically, and used for cultures. Sometimes, when the speculum is almost withdrawn, there is an escape of a considerable amount of pus from one or other of the para-urethral glands, and with a suburethral abscess there is a large amount of pus discharged, filling the lumen of the speculum. A sound passed through the speculum enters the pouch and determines its boundaries.

Chronic urethritis is a very persistent and obstinate disease. From the standpoint of treatment, it is important to distinguish it from cystitis, or to recognize a coexisting cystitis, which should be treated at the same time.

Treatment.—Let the patient be placed under as satisfactory hygienic conditions as possible and take as much rest as she can command. In addition, the urine should be made as bland as possible by drinking water freely. After determining, by careful examination, the location and extent of the disease, the urologist should then begin his treatments by using a 5 per cent. solution of nitrate of silver. A solution even as strong as 10 per cent. may be used once over a limited area. We find it best, after one such treatment, to continue the subsequent ones at intervals of 3 to 5 days, using weaker solutions, 2 to 3 per cent. An excellent method of treatment is light massage of the follicles over the dilator, with instillation into the urethra of iodine crystals, grm. 0.3 in 30 c. c. of albolene. Sometimes in old, obstinate cases we find it of the utmost advantage, when investigating, to dilate the urethral canal thoroughly from end to end, using Hegar dilators (Fig. 618), proceeding gradually upward to 12 or even 13 or 14 mm. in diameter. A dilatation of this kind is usually repeated two or three times subsequently at intervals of two or three weeks.

INFLAMMATION OF SKENE'S GLANDS.

Skene's glands are usually exposed by throwing aside the little labia which protect the orifice of the urethra much as the labia minora cover the vaginal orifice. By bending two hairpins and clipping them in with artery forceps a little speculum is made which usually exposes the outer portion of the urethra. When these glands are inflamed, one of them often projects out from the urethra as though a pea were buried in the tissue of that side, giving the urethral orifice

FIG. 618.—HEGAR DILATORS.
Two sizes are represented;
the series runs up by $\frac{1}{2}$ mm.
from 5 to 20.

an elliptical form. On pressure over this swelling a drop of pus exudes. In the older, more chronic forms of inflammation the para-urethral glands feel like little short wires embedded in the tissues on either side of, and parallel to the lower urethra (Fig. 620).

Treatment.—It is easy to wash out the glands by attaching a short piece of rubber tubing to the needle of a hypodermic syringe and closing the end with the fingers or tying it tight, so as to use the little instrument as a syringe to convey a fraction of a drop of pure alcohol or carbolic acid to the duct of the gland (Fig. 619). If this is not promptly successful the tissues can be cocaineized and the glands spread open in the direction of the vagina.

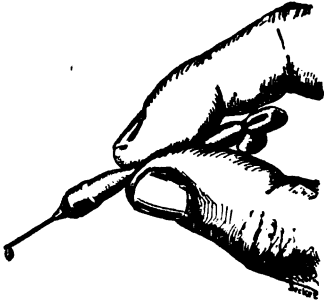


FIG. 619.—IMPROVISED SYRINGE FOR CARRYING MEDICAMENTS UP THE DUCTS OF SKENE'S GLANDS. A simple piece of rubber tubing is attached to a hypodermic needle, as shown. Suction is created by squeezing the tube and inserting the end of the needle into the fluid, then, as the tube is allowed to expand, the fluid is sucked in. To inject, the procedure is reversed.

EXTERNAL URETHRITIS.

There is a common form of chronic inflammation of the exposed mucous folds of the urethra in women who have borne children. The orifice is large, oval, and gaping, and the mucous membrane pouts out in more or less redundant folds, the larger parts lying posteriorly and at the sides. The hypertrophied mucosa is often tender and bleeds readily, causing a great deal of discomfort. We find daily applications of a 2 per cent. solution of nitrate of silver the best treatment. We are at present trying to shrivel up the mucosa by means of the Oudin spark, destroying little portions at a time.

SUBURETHRAL ABSCESS.

Suburethral abscess forms a symmetrical round swelling occupying the lower anterior vaginal wall, often appearing like a simple displacement of the suburethral mucosa. The abscess varies in size from 2 to 3 cm. in diameter, and is made up of the tissues of the vaginal wall and the urethral mucosa, without the muscular tissues of the vaginal wall, which are ruptured. The pocket thus formed contains urine, urinary salts, and pus, and communicates

with the urethra by a slit within the posterior wall, through which it discharges intermittently. If pressure is made on the tumor it diminishes in volume and the pus flows out of the urethra. A probe passed up the urethra enters the opening and the sac (Fig. 621).

FIG. 620.—ABSCESS OF GONORRHEAL ORIGIN IN SKENE'S GLAND TO THE LEFT OF THE URETHRA. Note the pushing forward of the tiny orifice of Skene's gland and the lateral displacement, compression and elliptical shape of the urethral orifice. (Mrs W., San., Nov. 15, 1904.)

The cause of the abscess is either the rupture of the muscular fibers of the urethra in labor, by compression between the symphysis pubis and the child's head, or an abscess forming in one of the glands at the base of the urethra.

Treatment.—Treatment of suburethral abscess is by a wedge-shaped excision of the sac with a careful removal of the diseased mucous lining, and the suture of the lining followed by the suture of the margins from side to side, restoring the floor of the urethra.

SYPHILIS OF THE URETHRA.

Primary syphilis of the urethra is rare. The syphilitic process ordinarily involves the urethra, with the surrounding parts, in a more or less extensive

ulcerative process which affects the tissues of the labia minora and the clitoris as well. The disease is generally seen in an ulcerative stage, with edema and infiltration of the surrounding parts with numerous irregular nodosities. The urethra is transformed into a thickened ulcerated canal, feeling more or less like cartilage; on all sides are the radiating scar tissues. As the disease advances the patient loses control of her urine. The disease is to be distinguished from a cancerous or a tuberculous process by taking scrapings from



FIG. 621.—LARGE SUBURETHRAL ABSCESS. Sagittal view in larger drawing, transverse view in smaller drawing. The abscess opens into the urethra by a small opening seen through the urethral speculum as indicated. (B. —, Dec. 30, 1899.)

the ulcerated surface and examining them carefully, under high, irregular illumination, for spirochetes. Patients who have such an extensive ulcerative process in the vulva also suffer from the general debility and the anemia of syphilis.

Treatment.—The treatment is that of the disease in general, which must be followed out for months and years. The local treatment ought never to be active, and may be confined to cleaning the parts and using applications of black wash. It is most important to avoid infecting other people by contact with the discharges. As far as our experience goes, patients who suffer from syphilis of this form are of the poorest class and are wretchedly nourished, being fit only to be sequestered in an asylum.

STRICTURE OF THE URETHRA.

Stricture of the urethra is comparatively rare in women. G. E. Herman, of London (*Trans. Lon. Obst. Soc.*, 1887, xxix, 27), up to 1886, could find only 23 cases in the literature, to which he added 6 from his personal experience. V. Winckel found 3 cases in a series of 3,000 gynecological patients. The stricture may either be due to injury received at labor (when it is more apt to lie in the upper part of the urethra), or it may be gonorrheal in origin. It easily involves a localized area of the urethra and is either linear or annular in form. There is a form of stricture, described by Herman, found in women of advanced age, well past the menopause, that involves the entire length of the urethra, which is thickened, hard, and greatly contracted from end to end. The contraction is sometimes so marked that it is impossible to pass a fine bougie. There is a thickened induration of the urethral vaginal connective tissue, with a hyperplasia which narrows the urethral canal. Herman considers this rare disease in women analogous to hypertrophy in the male. There is no history of gonorrhea.

In gonorrheal stricture of the urethra, according to Pasteau, the anterior orificial part of the urethra is more frequently involved. Pasteau (*Ann. des org. génito-urin.*, 1897, xv, 799) has collected 112 cases of stricture. The clinical history of such a case is not marked until the patient notes an increased difficulty in emptying the bladder, which difficulty may, in time, become extreme. The female bladder distends very rapidly and with a persistence of symptoms. Cystitis of more or less degree is sure to develop.

The narrowing of the urethra is always the result of a previous protracted disease which, however, may not have provoked any marked symptoms. In the obstetrical group of cases the stricture follows the labor within a few weeks.

If there is a concomitant vesical or urethral fistula, the stricture in the anterior part of the urethra will pass unnoticed until an examination is made with a view to operation. In examining a gonorrheal stricture a urethroscope is passed until it meets the resistance of the stricture, when the obturator is withdrawn and the dull, whitish scar tissue becomes visible. A careful examination with a searcher reveals the small lumen leading into the upper urethra. If a catheter is passed, it strikes the point of resistance and fails to enter the bladder. Sometimes the diagnosis of stricture is first made in this way by the nurse. Pasteau showed the importance of using an olive-pointed bougie, which distinguishes the exact site of the stricture as it is withdrawn, and by which one can also determine the presence of a second constriction.

Treatment of Stricture.—A stricture may be treated by one of the following methods:

- Electrolysis.
- Rapid dilatation.
- Slow dilatation.
- Incision and dilatation.
- Excision.
- Radium.

The simplest method of treatment is that of Robert Newman (*Amer. Jour. Med. Sci.*, 1875, lxx, 433) by means of electrolysis. A metallic dilator, introduced as far as the stricture, is the negative active pole. The patient holds the positive pole in her hand and a bougie just too large to pass the stricture is passed against it. The treatment begins with a strength of 30 amperes, increasing after several sittings up to as much as 70, lasting about 5 minutes at a time.

Newman thus describes the treatment: The positive of a 20-cell Drescher galvanic battery with a sponge electrode was held in the palm of the patient's hand. A No. 8½ olive-shaped metallic bougie was then introduced. The galvanic current was gradually increased to ten cells, the bougie slowly and gradually advanced, and every two minutes passed into the bladder. Immediately after, a No. 11 bougie was introduced in the same manner, the whole treatment lasting five minutes. The patient appeared to have been cured by three treatments and was perfectly well after 17 months, without a relapse.

The gauge of the strength of the application is a feeling of warmth and a pricking sensation short of decided pain.

If the stricture is not too tight nor spread over too large an area, it may be treated by rapid dilatation, putting the patient under gas anesthesia and passing Hegar dilators until the canal is enlarged by 2 or 3 mm. in diameter, or up to the size of the average glass catheter, 6 to 7 mm. After this preliminary rapid dilatation, gradual dilatation should be used, repeating the successive sets of dilators, until a No. 8 or 9 (diameter) can be passed. If the patient is sufficiently intelligent, it is a good plan to give her a dilator of the largest size and instruct her how to sterilize it, to cleanse the parts, and to introduce it well oiled. This she ought to do every day and report for further examination several weeks later.

A very tight stricture may be incised by a delicate knife through the endoscope. We prefer making multiple slight incisions and then gently passing the next size bougie. If there is much infiltration above the localized stricture area, making the restoration of the tissues a hopeless task, one may then make an annular resection of the urethra, cutting out the diseased parts.

We propose to try the use of 20 to 30 mgr. of r a d i u m in the next case, hoping it will promote the rapid resorption of the skin here as it does in keloid.

PERIURETHRITIS CHRONICA.

One sometimes sees an extreme hypertrophy and edema of the suburethral vaginal tissues consisting in a hypertrophy of the anterior vaginal wall just behind the urethral orifice. The inflamed, thickened tissues pout out of the vaginal opening between the labia in form like an egg, clearly resembling an extreme displacement of a cystocele. An examination shows the cervix well back in the vagina, the urethra not passing into the mass but over the symphysis in its normal direction to the bladder, and the disease limited to the localized thickening of the vaginal wall. The tissues are brawny and edematous and cannot, of course, be replaced. In a case which one of us (Kelly) saw in 1895 ("Operative Gynecology," i, 440) the condition was due to a stem pessary which had perforated the bladder and caused a stricture in the upper vagina, with an accumulation of pus (Fig. 552).

The treatment is to remove the manifest causes and then, if the conditions persist, to make a broad, wedge-shaped excision of the anterior vaginal wall down to, but not including the urethra, closing the wound with sutures from side to side.

CHAPTER XLII.

NEW GROWTHS OF THE URETHRA.

Tumors involving the urethra at any part of its canal, from bladder to external orifice, are rare. The thickenings and protrusions at the external orifice are almost always of an inflammatory nature. The internal orifice is sometimes encroached upon by papillomata of the bladder, which may invade the urethra for one-half cm. or more.

The following new growths have been described:

Caruncle.

Mucous polyp.

Fibroma and myoma.

Carcinoma.

Sarcoma.

CARUNCLE.

The appellation caruncle is an unfortunate one, as it means nothing more than "a little fleshy mass," a name without pathological significance and one which has given rise to considerable confusion. It is, however, about as significant as the somewhat similar name "sarcoma," when it was first used. A better name is the old appellation "vascular tumor." V. Winckel has applied the more descriptive title "papillary polypoid angioma."

English and French writers who have devoted particular attention to this distressing malady attach a more precise significance to the term.

Grégoire (*Ann. des mal. des org. génito-urin.*, 1904, xxii, 321) has written an excellent article entitled "Les polypes de l'urèthre chez la femme." A carefully illustrated article has also been written by Lange (*Ztschr. f. Geb. u. Gyn.*, 1903, xlviii, 122). The subject has been treated in English more from the clinical standpoint by Sir James Y. Simpson ("Clinical Lectures on Diseases of Women") and by William Goodell ("Lessons in Gynecology").

A true caruncle, in the classical sense of the word, is a florid, moist, vascular tumor, which may be sessile or pedunculate, occupying the margin of the urethral orifice; it is rugose and flattened like a raspberry, or wedge-shaped and

crenated, standing out from the urethra like a cock's comb pressed between the labia minora. The tumors are usually single, but there may be several. As the growth is vascular, it shrinks markedly and loses its bright red appearance when

FIG. 622.—TYPICAL URETHRAL CARUNCLE, SPRINGING FROM RIGHT POSTERIOR MARGIN OF URETHRA. Such a tumor is intensely red, is usually sessile, and frequently extends a little way upward into the urethra.

it is removed. It may resemble a prolapse of the urethral mucosa, but an attentive examination shows it attached at the urethral margin or springing from the mucosa within the orifice (Fig. 622). It bleeds a little at times; in rare instances, the patient may even become utterly anemic from the hemorrhages. It appears at any period of life. A typical caruncle is exquisitely sensitive to

touch, and even the act of urination may cause so much pain that it is deferred for hours, or the patient may retire to some sequestered place to cry and groan where she cannot be heard. One peculiarity is that the pain is not spontaneous. At times the health is completely wrecked. If the patient is married there may be an extreme vaginismus, and the mental state becomes utterly deplorable, the whole life revolving around the obsession of the little tumor within the vulva.

The clinical aspects of the case may be summarized by the statement that

FIG. 623.—URETHRAL CARUNCLE. Centrally, many of the vessels are in rather loose fibrous stroma; the surface is covered by a layer of partly squamous and partly transitional epithelium at margin.

the surgeon is invariably astonished at the remarkable disproportion between the size of the tumor and the excessive and agonizing pains caused by its presence.

Classical descriptions of the miseries of the condition are found in the writings of Simpson and Goodell.

A microscopic examination shows that the caruncle is a polypoid growth made up of an abundant connective tissue framework (Fig. 623), covered with squamous and transitional epithelium like that lining the lower urethra and its periphery. The connective tissue bears numerous blood-vessels. The folds of the mucosa dip superficially with the covering epithelium into the tumor. At no point does it present the slightest resemblance to a malignant affection. Peripherally there may be an entire loss of the epithelial covering and a round-celled infiltration.

A caruncle must not be confused with inflammatory growths of the margin of the urethra, which may also cause extreme pain, associated with an infiltration of the tissues, a pouting of the mucosa, and bleeding. It is evident, even to a cursory examiner, that these conditions, which may be due to gonorrhea, but are often found in young women in whom there is no possible suspicion of infection, are in no sense neoplastic.

An inflammatory condition differs from a new growth in that the latter is distinctly and evidently a localized tumor, springing from or grafted onto the tissues, and not simply a gross hypertrophy of the tissues themselves. Let us emphasize the fact that a caruncle does not become gangrenous like a urethral prolapse. The mere inspection of the parts suffices to reveal at once the presence of the exquisitely tender, bright red tumor at the urethra and to make the diagnosis clear.

Treatment.—The patient should be put under an anesthetic and the growth excised down to, and a little beyond its base. If not completely excised it may grow again. The base should then be carefully sutured with fine catgut.

MUCOUS POLYPL.

An interesting and rather rare growth is a polyp such as is shown in Fig. 624. These growths are practically always small and, like similar mucomembranous structures elsewhere, are composed entirely of epithelium and the underlying tissues.

FIBROMA, MYOMA AND FIBROMYOMA.

Although the urethral tissues supply abundant muscular and connective elements, fibroid growths and myomata are but rarely found. Büttner (*Ztsch. f. Geb. u. Gyn.*, 1894, xxviii, 136) describes myoma and gives two life-sized colored figures of the case. The patient, 40 years old, had an ulcerated tumor the size of a hen's egg projecting from the vulva; it produced no other symptom than frequent urination. The tumor arose from the upper part of the urethra, and the external, urethral orifice was converted into a slit 4 to 5 cm. broad. The extirpation was easy, by cutting into the tumor, opening its capsule, and shelling it out of its bed. A rapid recovery followed. Microscopic examination showed the tumor almost entirely made up of the smooth muscle fibers of the urethra.

Kretschmer cites a myoma of the urethra (*Trans. Chicago Path. Soc.*, 1909-

1911, viii, 173) where the tumor was of the size of a hazel-nut and lay close behind the external urethral orifice. It caused much disturbance in urination, and was found on removal to originate in the urethral muscle.

H. C. Coe (*Amer. Gyn. and Obst. Jour.*, 1898, xii, 815) reports a fibromyoma in a woman of 30. The tumor, which gave rise to no symptoms, was

FIG. 624.—MUCOUS POLYPI OF URETHRA AND SPHINCTER REGION OF BLADDER. The large drawing to the left is a sagittal view. The small drawings, (a) and (b), show a speculum view of the polypi. The inner polyp closed the vesical orifice of the urethra like a valve. (McA., June 9, 1902. From G. L. Hunner.)

smooth and elastic, the size of half an orange, projecting into the vagina and apparently embedded in the urethro-vaginal septum. An incision was made into the growth, which was easily enucleated with but slight hemorrhage. It was bilobed, one lobe extending up under the bladder. The wound was sutured and packed with gauze, and the patient made a rapid recovery.

Wetherill (*Am. Jour. Obst.*, 1901, xliii, 51) describes a fibromyoma of the urethra which the patient, who was 46 years of age and unmarried, had carried for 20 years. In this instance the urethra passed through the substance of the upper part of the tumor, which gave rise to some bladder irritation but was not tender or painful.

An incision was made over the tumor below the meatus, and the firm

fibrous mass easily enucleated except in its anterior portion, where it completely enveloped about $1\frac{1}{2}$ inches of the elongated dilated urethra. The outer coats of the urethra were removed for about 1 inch, leaving only the mucous membrane, which was perforated. The patient recovered with a small fistula and with imperfect control of the bladder. Complete control, however, was restored by means of a carefully fitted pessary. Microscopic examination showed the mass to consist almost entirely of fibrous tissue, with a few muscle fibers scattered through it.

I. Lönnberg (*Centralbl. f. Gyn.*, 1902, xxvi, 902) gives a review of 27 cases taken from the literature, and reports a case of a fibromyoma in a woman, 31 years of age, who had had considerable hemorrhage from a tumor the size of a hazel-nut inside the dilated urethral orifice. The growth was painful, firm, sharply circumscribed, and attached to the upper urethral wall. It was removed under infiltrating anesthesia and, as it was incapsulated, the enucleation was easy. The wound was closed with catgut, and the patient recovered.

Thomson (*Centrlbl. f. Gyn.*, 1906, xxx, 722) had a case of soft fibroma, about the size of a cherry, attached to the anterior urethral wall at about its middle portion. The patient had had no discomfort except that she noticed the tumor. Under narcosis the tumor was drawn out, its pedicle ligated, and it was removed. The patient recovered.

Paget ("Surgical Pathology," 1853, ii, 115 and 282) reports a fibro-cellular, pear-shaped tumor in a woman 34 years of age, pedunculate and attached to the upper urethral wall.

CARCINOMA.

Primary urethral carcinoma is a rare disease in which the cancerous affection takes its start in the mucous membrane at the external margin of the urethral canal or at some point between the external and internal orifice. We owe a most careful consideration of this subject to E. Ehrendorfer (*Arch. f. Gyn.*, 1899, lviii, 463). See also J. F. Percy, "Primary Carcinoma of the Urethra in the Female" (*Amer. Jour. Obst.*, 1903, xlvii, 457), and W. P. Manton (*Trans. Amer. Gyn. Soc.*, 1910, xxxv, 9). Carcinoma of the urethra has also been made the subject of several German inaugural dissertations.

Various Forms.—A primary urethral carcinoma may arise from the mucous membrane of the urethra or from Littre's or Skene's glands; either squamous-celled carcinoma or cylinder-celled (glandular form) (Fig. 625).

Ehrendorfer (*Arch. f. Gyn.*, 1899, lviii, 471) was the first to describe, as

vulvo-urethral carcinoma, a form beginning at the margin of the urethra and spreading out onto the vestibule (Fig. 626).

The first form spreads throughout the length of the urethra and extends into the bladder or pushes out into the neighboring tissues in cancerous nodes. It may appear at the external urethral orifice, ragged, deeply cleft, and bleeding.

FIG. 625.—PRIMARY SQUAMOUS CARCINOMA OF URETHRA. Shows the transitional epithelium normal to the urethra; under this there lies a fibrous stroma and back of that a mass of atypical epithelial cells. (Path. Museum, J. H. H.)

Its lymphatic extension is up the inside of the pubic ramis and into the inguinal glands. The superficial external form develops a hard, infiltrated, flattened area of ulceration spreading out over the surrounding mucosa, involving the vestibule and the clitoris, as well as up under the mucosa of the urethra.

Secondary urethral cancer is only too common following an affection of the uterine cervix. Nodules are felt first under the bladder and then under the urethra, until later the entire urethra becomes converted into a rigid tube-urethra in cuirass. This same involvement of the peri-urethral tissues is also found in the advanced cases of primary urethral cancer (Fig. 627).

Clinical History.—The history of a carcinoma is, first a stage of quiescence, in which there are no symptoms pointing to any local trouble. Later bleeding enters into the history of about half the cases. In some cases there is a discharge from the ulcerated surface which may be malodorous. There is surprisingly little disturbance in urination, although a poor woman in Melchiori's hands, one of the first cases reported, suffered violent spasms of pain while urinating. Cystitis characterizes the later stages. The growth is, as a

FIG. 626.—EHRENDORFER'S CASE OF CARCINOMA OF VESTIBULE COMPLETELY SURROUNDING AND INVOLVING URETHRAL ORIFICE. (*Arch. f. Gyn.*, 1899, lviii, 471.)

rule, not sensitive to touch. In 30 cases the average age was 54 years. There were 4 cases under 40; it appears mostly after the menopause, and is rarely found in a nullipara.

Etiology.—No cause can be positively assigned, but it is more than likely that the disease develops in a urethral orifice which has been affected with a low grade of chronic inflammation often found in women. Leukoplakia and "papilloma" have also been cited as causes.

Diagnosis.—A carcinoma may be mistaken for the ulcerative infiltrating lesions of syphilis, which it often closely resembles. A decision can be arrived at by taking a Wassermann reaction, and by examining the scrapings for spirochetes. The superficial vestibulo-urethral form of carcinoma may resemble tuberculosis, which presents a more even surface without the same tendency to

infiltration. Doubt will be dispelled by excising a piece for microscopic examination. An ulcerated fibroma of the urethra also resembles a carcinoma, but the fibroma is usually more of an isolated mass and can be shelled out of its capsule.

Treatment.—In an advanced case with infiltration it is useless to operate, and nothing can be done but drain the bladder to provide a free outflow of

FIG. 627.—ADENO-CARCINOMA OF URETHRA SECONDARY TO ADENO-CARCINOMA OF BODY OF UTERUS. There is a sparse fibrous stroma, some of the glands are choked with epithelium; others show a single layer. (Path. Museum, J. H. H.)

urine. All cases of movable tumor confined to the urethra should be treated with a wide excision. It is a wise precaution in every case to remove the glands from the groin for microscopic examination. The section of the gland with the scalpel will usually declare a carcinomatous infiltration. When the glands are affected they ought to be cleaned out.

The treatment of the carcinoma is by the thorough extirpation of the entire anterior portion of the urethra, even up to within 1 cm. of the neck of the bladder; if need be the bladder must be included. The best procedure for the

excision of the urethra is, we think, to cut around the disease on all sides at the urethral orifice, which is thus detached with the diseased mass from the vestibule. The dissection is then carried up under the symphysis on all sides, laying bare the pubic rami, and, by traction on the growth, step by step, up to the neck of the bladder, where the urethra is amputated well above its diseased portion. The mucosa is now sutured to the vaginal mucous membrane. Hemorrhage is stopped, as it is encountered, by ligation or, in case of the venous hemorrhage at the pubic rami, by passing sutures under the veins to constrict any oozing areas. The wounded surfaces left uncovered can be treated with dry dressings.

It is surprising to learn that these patients usually retain urinary control.

Another way to extirpate the urethra is to put the patient in the left lateral posture and to make incisions through the anterior lateral vaginal sulci, in this way isolating and extirpating the urethra, though we believe this plan is more liable to awkward hemorrhages.

A. F. McGill (*Lancet*, 1890, ii, 966) operated upon an epithelioma involving the urethra and a part of the base of the bladder, by making a suprapubic incision and using this as a means of pushing the growth down toward the vulva, where it was excised with scissors and scalpel. The suprapubic opening was then closed down to a drainage tube to be worn permanently. The wound in the base of the bladder, which was completely closed, formed a fistula which healed spontaneously. The patient was discharged with an opening above the symphysis, wearing a urinal.

We believe that these cases will be less liable to suffer from a relapse if, after the operation, a thorough application of massive doses (500 to 1,000 milligrams) of radium bromid are used for 12 to 24 hours, well shielded and brought into intimate contact with the affected parts. In Ehrendorfer's collection of 27 cases only 2 were free from a recurrence after from 3 to 6 years. R. Peterson had a case go 5 or 6 years, and Vineberg, 3 years, without relapse. E. Howdon operated on a squamous carcinoma in a woman of 76, removing almost the entire urethra and the glands in the right groin. She recovered and was well 2 years later.

SARCOMA.

Sarcoma of the urethra is among the rarest of the tumors of this region. The first account is Beigel's in his "*Krankheiten des weiblichen Geschlechtes*" (1875, ii, 674), with an excellent wood-cut (Fig. 628) and figures showing the microscopic characters of the growth. The next case is Ehrendorfer's (*Cen-*

tralbl. f. Gyn., 1892, xvi, 321). O. Nebesky (*Arch. f. Gyn.*, 1911, xciii, 539) cites all the known cases, 14 in number. He objects to the term peri-urethral, as inappropriate to a carcinoma, but a fitting designation for a sarcoma which begins in the connective tissues surrounding the urethra and spreads along the organ.

The individual cases for the most part are strikingly alike. Five women in his group were over 50 years of age; others were 32, 29, and 25, and in a case of Galabin (*Trans. Obst. Soc. of Lon.*, 1897, xxxviii, 120), the patient with a myxosarcoma was only 3 months old; the tumor, 3 inches in diameter, protruded from the dislocated, distended urethra and lay in the vagina behind the hymen. E. Hallervorden (I. D. Greifswald, 1896) reports a myxofibrosarcoma in a woman 52 years of age.

A description of Ehrendorfer's case is typical of most of this group. For 18 months the patient had noticed an enlargement at the urethral orifice and a bloody, watery discharge without odor. There was no active bleeding except from direct contact. There was a livid tumor protruding at the site of the urethra divided by deep fissures; the mass was attached at the lower and urethral margin. On making an incision, the tumor was found to

FIG. 628.—BEIGEL'S CASE OF SARCOMA OF URETHRA. The probe marks the point of the urethral orifice, which is surrounded by lobulated coxcomb masses of sarcomatous tissue of the urethral orifice. (*Cntrbl. f. Gyn.*, 1892, xvi, 323.)

have a brain-like grayish appearance; it was moderately firm, and showed small hemorrhagic areas. In 2 cases out of the whole number reported the patients were pregnant.

Sometimes the tumor occupies the urethral canal instead of its orifice, when it projects into the vagina, as a more or less smooth, circumscribed growth. In

one case the first symptom noticed by the patient was the enlargement of the inguinal glands. These tumors, on the whole, seem to be rather indolent.

A sarcoma may be mistaken for a mucous polyp or a prolapse of the urethral mucosa. If the tumor is large, livid, and deeply fissured the error will not be made. Sometimes, however, when it is small, a diagnosis can only be made after a microscopic examination.

Operation.—The operation consists in a wide excision of the urethra with the mass, beginning at the external orifice and carried around the disease on all sides, similar to the excision of a carcinoma. The dissection is then carried up under the symphysis as far as needs be, the urethra amputated and its mucosa stitched to that of the vagina.

Four of the fifteen cases remained free from recurrence after a considerable period.

It is naturally of importance here, as in all malignant disease, to operate at the earliest possible date. In any case that has advanced beyond the earliest period, it would be better to take out one or more glands from the groin for immediate microscopic examination; then, if any disease is found, to do a more radical operation, including all the glands.

Radium will doubtless prove a great boon here in assuring the results of the radical operation.

INDEX OF AUTHORS.

- ABT, 212
 ADAMI, 270
 ADRIAN, 359, 360
 AGNEW, 445
 AHLFELD, 482
 ALBARRAN, 2, 3, 4, 5, 7, 21, 26, 27, 30, 33,
 49, 60, 71, 72, 74, 112, 230, 236, 270,
 346, 347, 493, 506, 510, 522, 524, 526,
 558, 561
 ALBARRAN and IMBERT, 255, 264, 281
 ALBRECHT, 232
 ALEXANDER, 372, 487, 492
 ALSBERG, 342
 ANDERSEN, 495
 ANDREW, 302
 ASCH, 31, 483
 ASHURST, 445, 487, 489
 AVICENNA, 90
 AYERS, 131
 AYRES, 390

 BABES, 20
 BAKER, 343
 BAR, 213
 BARBER, 92
 BARDENHEUER, 24, 85, 506, 551
 BARRINGER, 3
 BARTELS, 487, 488, 489
 BARTH, 213, 215
 BARTHEZ and RILLIET, 23
 BATCHELOR, 391
 BAUMGARTEN, 29, 32, 217
 BAUMM, 346, 347
 BEAL, 96
 BEER, 534, 535
 BEIGEL, 597
 BELFIELD, 524
 BERGER, 389
 BERGENHEM, 391, 400
 BERMETZ, 498, 504, 505
 BERNARD, CHARLES, 91
 BERNARD and SALOMON, 38
 BESLEY, 487
 BEST, 377
 BIGELOW, 174, 176
 BILHARZ, 192
 BIRCH-HIRSCHFELD, 262
 BLACKBURN, 268
 BLANKAART, 91
 BLAUDEL, 305
 BLOCH, 238, 255, 264, 281, 282, 284, 286
 BLUM, 71, 565
 BLUMER, 357, 492
 BOECKL, 88
 BOGAJEWSKI, 520
 BOIS, 343, 344
 BOKAY, 165, 526
 BOLDT, 480, 481
 BOLK, 565
 BOREL, 32
 BORELIUS, 398
 BOTTOMLEY, 356
 BOUILLY, 497, 498, 499, 500, 505
 BOUSQUET, 343
 BOVEE, 97
 BOYER, 499
 BOZEMAN, 433, 435
 BRAASCH, 74, 76, 236, 276, 281, 282, 284,
 287, 309, 311, 325
 BRAMANN, 104
 BRAUN, 403
 BRENNER, 521
 BREWER, 219, 223, 224, 225
 BRIGHT, 33, 288
 BROCA, 4
 BROEDEL, 146
 BRÖSIKE, 320
 BRONGERSMA, 514
 BROWN, T. R., 99, 451
 BROWN, TILDEN, 22, 27, 49, 59
 BROWN-OSGOOD, 379
 BRÜCHANOW, 266, 268

- BRÜNING, 577, 578
 BRUNZEL, 237
 BRYAN, 20, 525
 BUCHANAN, 403
 BUERGER, 373, 381, 479, 480
 BURNAM, 207, 340, 466, 546
 BÜTTNER, 591
 BYFORT, 342

 CABOT, 108, 112, 211
 CALABRÈSE, 312
 CARTLEDGE, 493
 CASPER, 2, 86, 176
 CASPER and CITRON, 210
 CATHALA, 213
 CATHELIN, 561
 CAUDMONT, 327
 CAYLE, 29, 32
 CHESELDEN, 177
 CHEYNE, 312
 CHOPART, 506
 CHROBAK, 185
 CHUTE, 382, 384
 CIVIALE, 506, 561
 CLADO, 506, 518, 522, 524
 COE, 592
 COFFIN, 33
 COHN, 360, 487, 495
 COHNHEIM, 29
 COLUMBINO, 65
 COLZI, 343, 344
 COMHAIRE, 92
 CONE, 527
 CONITZER, 343
 CONSTANTINESCO, 58
 COVA, 215
 CRANWELL and VEGAS, 189
 CROISIER, 237
 CRUVEILHIER, 376
 CULLEN and DOERGE, 146
 CURET, 561
 CURRAN, 232
 CURTIS and CARLIER, 45, 272
 CZERNY, 92, 390, 392

 DARLING, 526, 527
 D'ARRIGO, 38
 DAVENPORT, 342
 DAVIS, E. P., 214, 215
 DE CHAULIAC, 90

 DE LAMBALLE, 418
 DE LA MOTTE, 499
 DE MARCHETTI, 91
 DEMARQUAY, 201
 DEPAUL, 342
 DEUBIERRE, 327
 DICKINSON, 20, 23, 24
 DIEULAFOY, 290, 555
 DOGIEL, 447
 DOUGLAS, 488
 DOWNS, 91
 DUDLEY, 426, 467
 DURAND, 568
 DURAND-FARDEL, 31, 32, 214
 DURET, 558
 DURHAM, 8, 92
 DURRIEUX, 373
 DUVAL, 3
 DUVAU, 201

 EASTMAN, 394
 v. EBERTS, 384
 EBSTEIN, 101
 EDEBOHLS, 8, 288, 289, 290, 291, 293, 295
 EHRENDORFER, 593, 597, 598
 EKEHORN, 71
 EMMETT, 342, 410, 466
 v. ENGELMANN, 484
 ENGLISCH, 356, 384
 ERLACH, 339
 ESCHERICH, 212

 FENGER, 85, 356
 FENWICK, 68, 188, 255, 481, 482, 526
 FINKELSTEIN, 212
 FINSTERER, 183
 FIRTH, 563
 FISCHER, 384
 FISHER, 24
 FLEISCHNER, 563
 FOERSTER, 513
 v. FORREST, 91
 FORSELL, 64
 FOULERTON and HILLIER, 32
 FOURNIER, 187
 FOURNIER and BEAUFUME, 32
 FOWLER, 3, 390, 396
 FRADI, 91
 FRANCK, 263
 FRANK, 296, 301

- FRANKLIN, 303
 FRAZIER, 292
 FRÈRE JACQUES, 165, 177
 FREUND, 7
 FREUND and v. ROSTHORN, 425
 FREYER, 176
 FRIEDENWALD, E. B., 212
 v. FRISCH, 3, 508, 509
 FRITSCH, 561
 FROMMEL, 568
 FRORIEP, 403
 FUERST, 564
 FULLER, 377
 FULTON, 3
- GAGE, 96
 GALABIN, 598
 GALAKTIONOW, 487
 GARCEAU, 197, 236, 238, 248, 262, 264, 268,
 269, 276
 GARRATT, 384
 GARRÉ and LECULU, 189
 GEF, 98
 GELLHORN, 185
 GERAGHTY, 211
 GERAGHTY and ROWNTREE, 289
 GÉRADIN, 498, 504
 GÉRARD, 312
 GERSTER, 348
 GERSUNY, 398, 522, 558, 559
 GOEBEL, 194, 349
 GOETZL, 112
 GOLDSBOROUGH, 113
 GOLDSMITH, 272
 GOODELL, 588, 590
 GÖPPERT, 212
 GORDON, G. L., 92, 94, 99
 GORDON, J. A., 500
 GRAHAM, 375
 GRANT, H. H., 493
 GRAWITZ, 251, 255
 GRÉGOIRE, 588
 GRAU, 98, 99, 105, 106
 GROHMANN, 264
 GROSS, 20, 39, 445, 525
 GRUBER, 502
 GUINSBOURG, 272
 GUITERAS, 232
 GUNN, 92
 GUTHRIE, 377
- GUYON, 5, 20, 59, 282, 498, 502, 506, 507,
 525
- V. HACKER, 392, 394
 HAECKEL, 272
 HALBAN, 184, 185
 HALL, 518
 HALLÉ, 262
 HALLÉ and MOTZ, 24, 52, 86, 446
 HALLERVORDEN, 598
 HALSTED, 131
 HAMBURGER, 161
 HAMILL, 23
 HAMMAN, 224
 v. HANSEMAN, 485
 HARRINGTON, 506, 546
 HARRISON, 8, 290, 375, 378, 384
 HARTMANN, 271
 HARTMANN and CUNEO, 270
 HAULTAIN, 482
 HERMAN, 585
 HEURTAUX, 503
 HEYMANN, 69
 HEYN, 38
 HICKS, 357
 HILDEBRAND, 296, 494
 HIPPOCRATES, 90
 HIRSCH, 99
 HIRSCHSPRUNG, 263
 HISS, 25
 HOBSON, 91
 HODGSON, 375
 HOFMOKE, 373
 HOFSTÄTTER, 563
 HÖHNE, 276
 HOLMES, 184
 HOLT, 212
 HOTTINGER, 71
 HOWDON, 597
 HOWSHIP, 19, 57
 HUBER, 277
 HUFSCMID, 277
 HUNNER, 3, 380, 424, 468
 HÜSLER, 526, 528
 HYRTL, 498
- ISRAEL, 2, 3, 5, 8, 21, 25, 26, 49, 60, 81, 84,
 94, 96, 98, 105, 109, 112, 133, 157,
 187, 188, 197, 236, 238, 264, 282, 284,
 352

- JABOULAY, 561
 JACKSON, 522
 JANET, 560
 JEFFREYS, 212
 JENCKEL, 75, 262
 JESSOP, 97
 JOBSON, 184
 JOHNSEN, 97
 JOHNSON, 303
 JONES, 487
 JOSSE, 346
 JUDD, 490, 492, 512, 522, 525, 547
 JURIDINI, 194

 KAUFMANN, 526, 527
 KAUSCH, 479
 KAUTSKY, 193
 KEATING-HART, 534
 KEEFE, 3
 KEEGAN, 176
 KELLY, 30, 74, 88, 120, 126, 144, 161, 204,
 210, 352, 356, 357, 437, 440, 442, 530,
 532, 558, 587
 KELYNACK, 237
 KERR, 487
 KLEBS, 507
 KLEINWÄCHTER, 474, 576
 KLEMPERER, 3
 KLOSE, 262, 264
 KOCH, 20
 KOLISKO, 339
 KÖNIGSTEIN, 110
 KÖRTE, 297, 298, 299, 300, 301
 KRAMER, 84
 KRETSCHMER, 591
 KROGIUS, 270
 KRÖNLEIN, 74
 KRUKENBERG, 481
 KÜMMELL, 98, 113, 115, 132
 KÜMMELL and GRAFF, 223
 KUNDRAT, 262
 KUNITH, 197
 KÜSTER, 98, 99, 230, 231, 232, 236, 296,
 307, 309, 506, 507

 LABUZE, 502
 LANCEREAUX, 20
 LANGE, 588
 LAUBRY and PARVU, 191

 LECORCHÉ and TALAMON, 33
 LE DENTU, 525
 LE FUR, 72, 217, 483, 479
 LEGUEU, 74, 106, 111, 164, 165, 187, 190,
 193, 213, 284, 515, 522, 544
 LEHR, 204
 LEITAO, 561
 LONDON, 391, 401, 402
 LENNANDER, 3, 49, 85, 223, 225
 LEONARD, 132, 137
 LERCHE, 379, 382, 384
 LE TOUR, 4
 LETULLE, 194
 LEWIS, BRANSFORD, 160
 LEWITT, 2
 LICHTENBERG and DIETLEN, 70
 LIEVIN, 352
 LINSER, 269
 LOEHLEIN, 481
 LOEWEN and GOLDSCHMIDT, 30
 LÖNNBERG, 593
 LOTHEISSEN, 392, 394
 LUBARSCH, 251
 LUSCHKA, 480
 LUZZATO, 276, 279
 LYON-CAEN and MARMIER, 309

 MAAS, 298
 MACGOWAN, 188
 MACKENRODT, 425, 439, 568
 MADDEN, 343, 346
 MALLINS, 233
 MANASSE, 191
 MANDELBAUM and ZUCKERKANDL, 510
 MANKIEWICZ, 270
 MANSON, 201, 202
 MANTON, 593
 MARCKWALD, 349
 MARGULIES, 188, 483
 MARTIN, 520
 MASSARI, 343, 344
 MAURY, 390, 391
 MAXSON, 343, 345
 MAYDL, 391, 399
 MAYO, C. H., 336, 547
 MAYO, W. J., 144
 MAYOS, the, 236
 MCGILL, 597
 MECKEL, 101
 MELCHIORI, 595

- MENDELSON, 101
 MENGE, 298
 MICHAËLIS, 211
 MIRABEAU, 213
 MILTON, 343
 MILWARD, 278
 MOCK, 481
 MOLNOV, 7
 MONRO, 560
 MONSARRET, 355
 MONTEFORT, 507
 MORGAGNI, 19, 27
 MORITZ, 101
 MORRIS, H., 20, 21, 22, 23, 24, 25, 26, 84,
 92, 296, 306, 309, 311, 318
 MORRIS, M., 483
 MORRIS and SOCIN, 318
 MOSCHOWITZ, 277
 MOSCOW, 65
 MOTZ, 2, 507
 MOTZ and DENIS, 445
 MÜLLER, 391
 MUNDÉ, 97, 575, 578
 MUUS, 262

 NAUWERCK, 277
 NECHOLICH, 2
 NEILSON, 302
 NEUDÖRFER, 389
 NEUHÄUSER, 132
 NEUMANN, 187, 297
 NEWLAND, 118, 401, 402
 NEWMAN, D., 27
 NEWMAN, R., 586
 NICAISE, 190, 192
 NICOLAÏER, 207
 NICOLICH, 189
 NITZE, 176, 178, 182, 483, 486, 520, 530
 NIXON, 217

 OBERTEUFER and REVOLET, 348
 OBICI, 339, 340
 O'NEIL, 193
 OPITZ, 213
 OSLER, 275
 OTT and SCOTT, 563

 PAGET, 556, 593
 PALFYN, 342
 PANCOAST, 390

 PARDOE, 89
 PARK, 276
 PASCAL, 405
 PASTEAU, 585
 PATOIR, 27
 PAUZAT, 505
 PAWLIK, 551, 558
 PEAN, 372
 PECHÈRE, 72
 PEDERSEN, 89
 PELS-LEUSDEN, 31
 PERCY, 593
 PETERS, G. A., 20
 PETERS, GEORGE A., 391, 400, 401, 402
 PETERSON, 597
 PICQUÉ and REBLAUB, 7
 POHL, 97
 POLACK, 309, 311
 POLAILLON and LE GRAND, 525
 POSNER, 22, 23, 297
 POUSSON, 27, 60, 74, 84, 292, 295, 379, 381,
 383, 498
 POZZA, 400
 PROKSH, 188, 349
 PRYOR, 67

 QUÉNU and PASTEAU, 183
 QUICK, 487, 490, 492

 RAFIN, 60, 71, 72, 286
 RAFIN and ARCELIN, 164
 RAMBAUD, 270
 RAMSAY, J., 97
 RAMSAY, O., 75, 265, 267, 268, 269, 270
 RANDALL, 3
 RANSOHOFF, 112
 RASCH, 572
 RAU, 177
 RAYER, 1, 19, 25, 27, 33, 90, 91, 187, 203,
 204, 232, 275, 356
 RÉBLAUB, 213
 RÉCAMIER, 275
 REIDNER and MAUNDER, 92
 REIGEL, 525
 REITER, 211
 REMBRANDT, 91
 RETZIUS, 497, 498
 REVEL, 561
 RICHARDSON, 481
 RIOLAN, 91

RIVINGTON, 488
 ROCHET, 72
 ROSENBAACH, 104
 ROSENSTEIN, 39
 ROUX, 390
 ROVSING, 89, 96, 104, 112, 211, 336
 RUHRÄH, 196
 RUMPEL, 520, 521
 RUNDLE, 262
 RUSSELL, 5, 7

SABATIER, 1, 499
 SALTYKOW, 349
 SALUS, 33
 SAMPSON, 31, 130
 SÄNGER, 517
 SAPPEY, 327
 SAVIARD, 348
 SCHATZ, 520
 SCHEDE, 3, 223
 V. SCHLANGE, 392
 SCHLANGER, 492
 SCHLESINGER, 60
 SCHMIDT, 391, 392
 SCHMIDTLEIN, 20
 SCHRADER, 343
 SCHÜLLER, 72
 SCHURIG, 91
 SCHWARZ, 343, 346
 SEEFISCH, 104
 SENATOR, 3, 71
 SENN, 487
 SERAPION, 90
 SERRALLACH, 561
 SIEBER, 275, 276, 277, 278, 292
 SIMON, 20, 272, 356, 417
 SIMPSON, 588, 590
 SINGER, 574
 SINNREICH, 349
 SIPPPEL, 214
 SMITH, J. F., 132
 SMITH, S., 486
 SMITH, THOMAS, 92
 V. SOEMMERRING, 525
 SOLLER, 343, 344
 SONDILLE, 164
 SONNENBURG, 390, 392, 394, 486
 SPANGARO, 526
 SPIESS, 187
 SPOONER, 385

STANTON, 197
 STAVELEY, 1
 STEFFEN, 262
 STEINMETZ, 526
 STEINTHAL, 21, 26
 STICH, 2
 STILES, 390, 398, 572, 573
 STOECKEL, 183, 481, 520, 522, 540, 579
 STOERK, 255
 STOERK and ZUCKERKANDL, 446, 448
 STRETTON, 564
 STROMBERG, 231

 TAIT, 479
 TANGL, 347
 TARGETT, 384
 TAUFFER, 340
 TAUFFER and VELITS, 339
 TÉDENAT, 204
 TERRIER and LECÈNE, 268
 THALER, 481
 THIERSCH, 390
 THIERSCH and BILLROTH, 391
 THILLOW, 339
 THOMAS, B. A., 534
 THOMPSON, 506, 518
 THOMSON, 593
 THORP, 493
 TIKANADZE, 487, 495
 TOWNSEND, 232
 TRAPPE, 262, 263
 TRÉCOURT, 498
 TRENDLENBURG, 390, 393, 428, 506, 539
 TREUB, 5
 TRÖMMER, 560
 TUFFIER, 21, 28, 40, 41, 60, 275, 399, 486
 TUFFIER and KLIPPEL, 45
 TULP, 91
 TYSON, 91, 292
 TYSON and FRAZIER, 292

 ULLMAN, 492

 VAN DAM, 372, 381
 VEAU, 347
 VIANNAY, 57
 VIGNARD and THÉNEVOT, 24
 VIGNERON, 24, 26, 74
 VILLIERS, 498, 501, 505
 VINEBERG, 45, 597

VIRCHOW, 31, 268, 277, 506
VOELCKER and LICHTENBERG, 222
VOLKMANN, 178

WAGNER, 231, 305, 349

WALDEYER, 239

WALDSCHMIDT, 485

WALDSTEIN, 563

WALKER, 22, 23, 26, 29, 30, 31, 176, 217,
262, 263

WALSHAM, 32

WALTER, 486, 487, 493

WARREN, 481, 482

WATSON, 85, 112, 508, 551

WATSON and CUNNINGHAM, 262, 487,
492

WAUGH, 212, 213, 264, 480

WESTERMAN, 110

WETHERILL, 592

WHITACRE, 399

WILDBOLZ, 71

WILLIAMS, H. T., 85

WILLIAMS, J. W., 499

WILLIAMS, W. R., 263, 266

WILMS, 223, 225

WILSON, 238, 255, 262, 264

v. WINCKEL, 568, 585, 588

WOLFER, 487, 494

WOOD, 390

WOOLSEY, 390

WOSHIMASU, 232

WRIGHT, 196

YOUNG, 7, 28, 92, 118, 126, 157, 176, 222,
372, 376, 381, 382, 384, 517

ZAMBECCARI, 91

ZEIDLER, 490

ZESAS, 400

ZUCKERKANDL, 513

INDEX OF SUBJECTS.

- Abbe's incision, i, 381
- Abscess, perirenal, diagnosis of, ii, 234
 perirenal, etiology of, ii, 231
 pathological anatomy of, ii, 231
 pointing of, i, 6
 prognosis of, ii, 234
 due to renal calculus, ii, 106
 secondary to renal tuberculosis, ii, 42
 symptoms of, ii, 233
 treatment of, ii, 235
- prevesical, causes of, ii, 502
 clinical history of, ii, 499
 diagnosis of, ii, 502
 differential diagnosis of, ii, 503
 literature of, ii, 505
 symptoms of, ii, 500
 treatment of, ii, 504
 subumbilical, diagnosis between, and
 prevesical abscess, ii, 503
- suburethral, ii, 582
 appearance of, i, 239, 244
 treatment of, ii, 583
- Abscesses, multiple, of kidney, ii, 216, 225
- Acidity, estimation of, in urine, i, 209
- Actinomyces bovis, ii, 196
- Actinomycosis, ii, 196
 diagnosis of, ii, 200
 etiology of, ii, 196
 mortality from, ii, 201
 pathology of, ii, 196
 symptoms of, ii, 200
 treatment of, ii, 201
- Adenoma, of bladder, ii, 515
 of kidney, ii, 239
- Adrenal bodies, accessory relation of, to
 kidneys, i, 72
 arteries of, i, 72
 attachment of kidney to, i, 465
 lymphatics of, i, 72
 nerves of, i, 72
 relation of, to kidney, i, 71
 tumors of. See Adrenal tumors
- Adrenal glands. See Adrenal bodies
- Adrenal tumors, ii, 265
 benign, ii, 267
 classification of, ii, 267
 course of, ii, 269
 diagnosis of, ii, 269
 frequency of, ii, 265
 malignant, ii, 268
 occurrence of, ii, 267
 premature development associated with,
 ii, 269
 symptoms of, ii, 269
 treatment of, ii, 270
- Adrenalin, for hematuria, i, 225
- Adults, prolapse of urethra in, ii, 574
- Ärocystoscope. See Air cystoscope
- After-treatment, in kidney operations, i,
 415
- Age, influence of, on form of renal tuber-
 culosis, ii, 23
 on renal calculus, ii, 98
 in relation to malignant disease of kid-
 ney, ii, 238
 in relation to movable kidney, i, 467
 in relation to vesical calculus, ii, 166
- Air cystoscope, advantages of, i, 248, 282
 method of using, i, 248
 in topical treatment of cystitis, ii, 465
 in vesical tumors, ii, 530
- Albarran type of catheterizing cystoscope,
 i, 290
- Albarran's incision, i, 381
- Albumin, in normal urine, i, 205
 in pyuria, i, 216
 relation between, and pus in pyuria, i,
 217
 tests for, i, 205, 208
 in hematuria, 205, 208, 221
- Albuminuria, Cull's, i, 206
 with cystitis, ii, 451
 with healthy kidneys, i, 205
 with hematuria, i, 221

- Albuminuria, with injury to kidney, i, 207
 with movable kidney, i, 499
 with nervous diseases, i, 207
 "postural," i, 206
 with renal calculus, ii, 116
 with renal tuberculosis, ii, 66
 with syphilis, ii, 187
- Alcohol, effect of, upon mortality from rupture of bladder, ii, 489
- Anatomy of kidney, 127
- Anemia, as complication of renal tuberculosis, ii, 56
 with renal calculus, ii, 115
- Anesthesia, gas, in intracapsular nephrectomy, ii, 83
 gas and oxygen, in operation for injuries of kidney, ii, 300, 302
 general, in examination of bladder, i, 251
 in examination of cystitis, ii, 452
 for dilatation of urethra, ii, 586
 objections to, in polycystic kidney, ii, 281
 in operation for rupture of bladder, ii, 493
 in operation for vesical calculus, ii, 175
 in operation for vesico-vaginal fistula, ii, 413
 in removal of vesical calculus by suprapubic section, ii, 181
 in transvesical removal of ureteral calculus, ii, 162
- local, in cystoscopic examination, i, 296
 in examination of bladder, i, 251
 in nephrectomy for renal tuberculosis, ii, 83
 in operation for injuries to kidney, ii, 300
 in operation for rupture of bladder, ii, 493
 in operation for vesical calculus, ii, 175
 in operation for vesico-vaginal fistula, ii, 413
 in removal of vesical calculus by suprapubic section, ii, 181
 in surgical treatment of Bright's disease, ii, 293
 in transvesical removal of ureteral calculus, ii, 161, 162
- Anesthesia, spinal, in operation for rupture of bladder, ii, 493
- Anesthetic, choice of, for renal operations, i, 378
- Aneurysm as sequel to rupture of kidney, ii, 297
- Angioma, of bladder, ii, 525
 of renal parenchyma, ii, 237
 of renal pelvis, ii, 237
- Angioneurotic bleeding kidney. See Hematuria, essential
- Animal experimentation, evidence afforded by, on tuberculous infection through ureter, ii, 29
- Animals, forms of renal pelvis characteristic of, i, 139
- Anomalies, urethral, ii, 564
- Anuria, calculous, ii, 111
 as indication for operation for renal or ureteral calculus, ii, 164
 after injury to ureter, ii, 306
 in polycystic kidney, ii, 279
 with renal and ureteral calculus, ii, 111
 with rupture of bladder, ii, 490
 with rupture of kidney, ii, 298
- Aorta, displacement of, in operations on kidney, i, 394
- Apparatus, for collecting urine from vesico-vaginal fistula, ii, 422
 for determining freezing point of urine, i, 310
 for evacuation of bladder, i, 254
 for irrigation in cystitis, ii, 462
 for use in dye tests of renal insufficiency, i, 317
 for use in progressive distentions of bladder, ii, 463
 for use of X-ray, i, 347
- Appendicitis, essential hematuria associated with, ii, 3
 movable kidney associated with, i, 457
 pyelitis in children associated with, ii, 212
- Appendix vermiformis. See Vermiform appendix
- Arterial blood system, as avenue of infection in renal tuberculosis, ii, 31
- Arteries, of adrenal bodies, i, 72
 of bladder, ii, 368
 capsular, i, 429
 of lumbar region, i, 16

- Arteries, renal, arrangement of, in reference to nephrotomy, i, 419
 comparison of, with renal veins, i, 435
 of cortex, i, 160
 development of, i, 93
 distribution of, in relation to renal operations, i, 427
 irregularities of, in relation to renal operations, i, 427
 supernumerary, i, 427
 umbilical, i, 85
 of ureter, 170
 of urethra, ii, 371
- Artery, renal, branches of, i, 160
 division of, i, 428
 length of right, i, 465
- Aspiration, in hydronephrosis, i, 547
 in litholapaxy, ii, 175
- Asthma, with movable kidney, i, 493, 494
- Atrophy of kidney, ii, 310
- Axes of kidneys, horizontal, i, 45
 relation of, to large vessels of abdomen, i, 74
 vertical, i, 47
- Bacillus *aërogenes capsulatus* in pneumaturia, 227
- Bacillus *lactis aërogenes* in pneumaturia, i, 227
- Bacillus *tuberculosis*. See Tubercle bacillus
- Bacteria, causing cystitis, i, 231, 232, 233, 234; ii, 445, 456
 examination of urine for, i, 212
 excretion of, through healthy kidneys, i, 234
 identification of, in urine, i, 235
 in normal urethra, i, 229
 in normal urine, i, 234
 in nuclei of renal calculi, ii, 99
 in pyuria, i, 214, 216
 with renal calculi, ii, 116
 in renal infections, ii, 217
 in upper urinary passages, 230
 treatment of cystitis based on, ii, 458
- Bacteriuria, i, 229
 in acute infectious disease, i, 234
 avenue of infection in, i, 233
 due to chronic constipation, ii, 480
 diagnosis between, and cystitis, ii, 455
 diagnosis of, i, 235
- Bacteriuria, with healthy kidneys, i, 234
 relieved by removal of appendix, ii, 212
 treatment of, i, 235
- Baer's cystoscope, i, 285, 290
- Balloon, use of, in operation for vesical diverticulum, ii, 382
- Bandage in hydronephrosis, i, 548
- Bandages in treatment of movable kidney, i, 502, 518
- Bardenheuer's incision, i, 380
- Barn-door incision, i, 406
- Becher and Lennhoff's index, i, 475
- Beckmann thermometer, i, 310
- Belted kidney, ii, 51
- Betts, in treatment of movable kidney, i, 502
- Bergenheim's operation, for exstrophy of bladder, ii, 400
- v. Bergmann's incision, i, 380
- Bigelow's lithotrite, ii, 174, 176
- Bilharziosis, ii, 192
 diagnosis of, ii, 196
 mode of infection in, ii, 193
 occurrence of, ii, 193
 parasite of, ii, 192, 193
 pathological anatomy of, ii, 194
 stricture of ureter associated with, ii, 349
 symptoms of, ii, 195
 treatment of, ii, 196
- Bimanual examination, in diagnosis of vesical calculus, ii, 170
 in diseases of prevesical space, ii, 503
 of kidneys, i, 242
 of ureters, i, 240
 for ureteral calculus, ii, 117
 for vesical tumor in children, ii, 529
- Bismuth injection, as aid to X-ray examination, i, 368; ii, 379
- Bladder, anatomy of, i, 196; ii, 361
 female, ii, 361
 anesthesia in examination of, i, 251
 apparatus for evacuation of, i, 254
 arteries of, ii, 368
 avenue for infection of, i, 233
 bimanual examination of, i, 240
 blood supply of, i, 197
 calculus of. See Calculus, vesical
 capacity of, ii, 361
 under progressive distention, ii, 463

Bladder, catheterization of. See Catheterization of bladder

- changes in, due to calculi, ii, 168
- cicatrices in, due to cystitis, ii, 475
- contracted. See Contracted bladder
- contraction of, ii, 361
- dependence of, on central nervous system, i, 199
- development of, ii, 362
- diseased conditions of, suitable for X-ray diagnosis, i, 352, 367
- distention of, ii, 361
- disturbance of, associated with movable kidney, i, 490
- diverticulum of. See Diverticulum, vesical
- divisions of, i, 261
- examination of, with air cystoscope, i, 248
- excision of, for vesical tuberculosis, ii, 87
- exstrophy of. See Exstrophy of bladder
- external anatomical relations of, i, 260
- extraperitoneal surface of, ii, 363
- function of, i, 198
- hematuria due to abnormalities of, i, 220
- hour-glass contraction of, ii, 377
- hydatid disease of, ii, 192
- immunity of, in renal tuberculosis, ii, 59
- incrustation of, ii, 449
- influence of intra-abdominal pressure on emptying of, i, 201
- influence of nervous system upon, i, 199
- injuries of. See Injuries of bladder and urethra
- innervation of, i, 197
- inspection of, i, 248
 - with water cystoscope, i, 297
- interior of, when contracted, ii, 364
 - when distended, ii, 364
- irritability of. See Irritable bladder
- lesions in, caused by Bilharzia hematobia, ii, 194
- ligaments of, ii, 363
- lymphatics of, ii, 369
- manner of emptying, i, 202
- measurement of, i, 254
- method of examining interior of, i, 255
- mucous membrane of, i, 197
- musculature of, i, 196

Bladder, nerves of, ii, 369

- neuroses of. See Neuroses of bladder
- normal capacity of, ii, 451
- operations on. See Operations on bladder
- pain in, as means of diagnosis, i, 373
- peritoneal covering of, ii, 362
- physiology of, i, 196
- preliminary filling of, for cystoscopic examination, i, 296
- prolapse of vesical end of ureter into, ii, 357
- resection of, for carcinoma, ii, 550
- rupture of, ii, 487
 - classification of causes for, ii, 488
 - diagnosis of, ii, 490
 - diagnosis between, and rupture of kidney, ii, 491
 - etiology of, ii, 488
 - incomplete, ii, 495
 - literature on, ii, 487
 - mortality from, ii, 489, 492
 - in pregnancy, ii, 488
 - prognosis in, ii, 492
 - sequelæ of, ii, 489
 - treatment of, ii, 492
 - when incomplete, ii, 495
- sensation of fullness in, i, 199
- shape of, when contracted, ii, 361
 - when distended, ii, 362
- size of, when contracted, ii, 361
- stalagmite, ii, 449
- stone in. See Calculus, vesical
- structure of, ii, 365
- studies in nerves, stimulation of, i, 200
- symptoms connected with, in pyelitis, ii, 205
 - in renal and ureteral calculi, ii, 111
 - in renal tuberculosis, ii, 57
 - in urological diagnosis, i, 372, 373
- syphilis of. See Syphilis of bladder
- theories in regard to function of, i, 198
- topography of female, ii, 361
- total extirpation of, for carcinoma, ii, 551
- tuberculosis of. See Tuberculosis of bladder
- ulcer of. See Ulcer of bladder
- veins of, ii, 369

Blastema, development of, i, 103

- Blood, amount of, passing through kidney, i, 184
 capacity of, to catalyze hydrogen peroxid, i, 306
 chemical and physical constitution of, in relation to renal secretion, i, 183
 cryoscopy of, i, 305
 freezing point of, i, 305
 functional tests for renal incapacity dependent upon examination of, i, 304
 peculiar conditions of, a source of hematuria, i, 220
 physical changes in urine due to presence of, i, 221
 relation between hemolytic power of, and that of sodium chlorid solutions, i, 306
 symptoms pointing to source of, in hematuria, i, 222
 in urine. See Hematuria
 vomiting of. See Hematemesis
- Blood cells, red, estimation of, in urine, i, 222
- Blood pressure, influence of, on renal secretion, i, 183
- Blood-vessels of abdomen, relation of kidneys to, i, 74
 arrangement of, in abnormally placed kidneys, ii, 325
 of lumbar region, i, 16
 renal, effect of rotation of kidney upon, i, 124, 133
 tension of, in operations on kidney, i, 392
 of tubular part of kidney, i, 179
 supernumerary ureteral, i, 525
- Body form, influence of, on incision for exposure of kidney, i, 384
 on mobility of kidney, i, 474
- "Border nerves," i, 28
- Borelius' operation for exstrophy of bladder, ii, 398
- Bouchard's test, i, 307
- Bougie, graduated, in diagnosis of stricture of ureter, ii, 353
- Bowels, evacuation of, preparatory to renal operations, i, 377
- Bowman's capsule, structure of, i, 178
- Bowman's theory of renal secretion, i, 176
- Braasch cystoscope, i, 289
- Bransford-Lewis cystoscope, i, 285, 289, 294, 298
- Brenner cystoscope, i, 285, 290
- Bright's disease, composition of blood in, i, 301
 definition of, ii, 288
 etiology of, ii, 288
 fatal hemorrhage in, i, 224; ii, 5
 hematuria in, i, 224
 pathology of, ii, 288
 as sequel to rupture of kidney, ii, 297
 surgical treatment of, ii, 288
 general considerations in, ii, 288
 history of, ii, 289
 indications for, ii, 292
 preparation of patient for, ii, 293
 results of, ii, 291, 294
 technique in, ii, 293
 symptoms of, ii, 288
- Brown-Buerger cystoscope, i, 285, 289, 293, 298
- Calculus, renal, ii, 90
 age in regard to frequency of, ii, 98
 average position of, i, 352
 bacterial infection due to presence of, ii, 106
 catheterization of ureters in diagnosis of, ii, 117
 character of, ii, 92
 chemical composition of, ii, 92
 colic as symptom of, ii, 107
 complete anuria with, ii, 111
 cystin, ii, 95
 determining factors in, ii, 99
 diagnosis of, ii, 114
 with double pelvis and ureter, ii, 126
 etiology of, ii, 92
 examination of patient for, ii, 114
 examination of urine with, ii, 115
 excretion of indigo-carmin in, i, 319
 expectant treatment for, ii, 136
 extraction of, ii, 143, 149
 fixed pains with, ii, 109
 functional tests in diagnosis of, ii, 123
 gastro-intestinal symptoms with, ii, 111
 geographical localities favoring, ii, 99
 hematuria with, ii, 110, 115
 hemorrhage in removal of, i, 443

- Calculus, renal, history of, ii, 90
 hydronephrosis associated with, ii, 125, 528, 550
 incision for exposure of, ii, 139, 145
 indications for operative treatment of, ii, 138
 infection with, ii, 116
 intracapsular enucleation in operation for, ii, 153
 mortality after operation for, ii, 164
 movable kidney associated with, i, 470
 nephrectomy for, ii, 152
 nephrolithotomy for, ii, 145
 nephrolithotomy followed by nephrectomy for, ii, 153
 number of, ii, 97
 operation for, ii, 138
 oxalate, ii, 94
 palpation for, ii, 116
 pathological changes in kidney produced by, ii, 104
 percussion for, ii, 117
 phosphate, ii, 94
 physical structure of, ii, 92
 position of, in general, i, 352
 pyelotomy for, ii, 139
 race as influence in, ii, 99
 relative frequency of, in sexes, ii, 98
 removal of, by pyelotomy, i, 441
 as sequel to rupture of kidney, ii, 297
 shape of, ii, 97
 size of, ii, 96
 spontaneous passage of, ii, 110
 symptoms of, ii, 106
 transferred pain in, ii, 109
 treatment of, ii, 136
 treatment after operation for, ii, 163
 urethral symptoms with, ii, 111
 uric acid and urate, ii, 94
 vesical symptoms with, ii, 111
 wax-tipped catheter in diagnosis of, ii, 126
 X-ray in diagnosis of, ii, 132, 352
- ureteral, 90
 anuria with, ii, 111
 catheterization of ureters in diagnosis of, ii, 117
 in children, ii, 99
 cystin, ii, 95
- Calculus, ureteral, diagnosis of, ii, 114
 dislodgment of, from ureteral orifice, ii, 160
 distinction between, and phleboliths, i, 363
 etiology of, ii, 92
 expectant treatment of, ii, 136
 with exstrophy of bladder, ii, 390
 general examination of patient for, ii, 114
 indications for operative treatment of, ii, 138
 method of determining distance of, from kidney, ii, 120
 mortality after operation for, ii, 164
 operation for, ii, 154
 oxalate, ii, 94
 palpation for, ii, 116
 phosphate, 94
 removal of, from near pelvic brim, ii, 155
 from pelvic floor, ii, 156
 from upper ureter, ii, 154
 from vesical end of ureter, ii, 157
 renal colic with, ii, 109
 shape of, ii, 97
 size of, ii, 96
 spontaneous passage of, ii, 137
 transvesical removal of, ii, 160
 treatment for, ii, 136
 treatment after operation for, ii, 163
 vaginal examination for, ii, 117
 vesical symptoms with, ii, 111
 wax-tipped catheter in diagnosis of, ii, 120, 126
 X-ray in diagnosis of, i, 362; ii, 132
- urethral, ii, 183
 age in relation to, ii, 183
 clinical history of, ii, 185
 diagnosis of, ii, 185
 in diverticulum, ii, 185
 location of, ii, 184
 nucleus for, ii, 184
 origin of, ii, 184
 sex in relation to, ii, 183
 treatment of, ii, 186
- vesical, ii, 165
 changes in bladder caused by, ii, 168
 diagnosis of, ii, 169

- Calculus, vesical, in diverticulum, i, 368
 etiology of, ii, 166
 formation of, ii, 165
 history of, ii, 165
 litholapaxy for, ii, 174
 lithotripsy for, ii, 174
 location of, ii, 168
 measurement of, ii, 171
 number of, ii, 167
 occurrence of, ii, 165
 operations for, ii, 170
 perineal section for, ii, 177
 relative frequency of, in sexes, ii, 165
 shape of, ii, 167
 size of, ii, 167
 suprapubic section for, ii, 180
 symptoms of, ii, 168
 vaginal operation for, ii, 179
 X-ray in diagnosis of, i, 368; ii, 170
- Calibrator, use of, in examination of bladder, i, 252
- Calices, renal, development of, i, 118
 direction of, i, 149
 effect of rotation of kidney upon direction of, i, 132
 epithelium of, i, 159
 number of, i, 122, 139
 major, i, 142
 minor, i, 143
 shape of, i, 146
 size of, i, 144
- Cancer of cervix, vesico-vaginal fistula due to, ii, 407
- Capsula adiposa. See Perirenal fat
- Capsule, fatty, method of opening, i, 408
 vascularization of, i, 163
 fibrous macroscopic structure of, i, 150
 fibrous fatty, change in, with renal calculus, ii, 105
 tendinous, vascularization of, i, 163
- Capsulectomy, for Bright's disease, ii, 293
- Carbolic acid, local use of, in vesical tuberculosis, ii, 89
- Carcinoma, of bladder, ii, 516
 treatment of, ii, 550
 of kidney, ii, 239
 renal. See Carcinoma of kidney
 of urethra, ii, 593
 clinical history of, ii, 595
 diagnosis of, ii, 595
- Carcinoma of urethra, etiology of, ii, 595
 forms of, ii, 593
 prognosis in, ii, 597
 treatment of, ii, 596
- Cargentos, i, 350
- Caruncle, urethral, ii, 588
 treatment of, ii, 591
- Case, of abnormal frequency of urination due to excessive water drinking, ii, 555
 of abnormal mobility of both kidneys in different degree, i, 467
 of acute pyelonephritis, benefited by medical treatment, ii, 224
 of adenocarcinoma developing on exstrophy of bladder, ii, 389
 of asthma with movable kidney, i, 494
 showing benefit from non-operative treatment of movable kidney, i, 502
 of benign papilloma of bladder in child, ii, 526
 of chronic rheumatism relieved by nephrectomy for chronic pyelonephritis, ii, 226
 of congenital vesical diverticula, ii, 373
 of contracted bladder treated by enlargement with loop of ileum, ii, 479
 illustrating course of actinomycosis, ii, 200
 of cystic kidney secondary to renal tuberculosis, ii, 45
 of cystic tumor in adrenal gland, ii, 268
 of dermoid cyst of kidney, ii, 272
 of double pyonephrosis with calculi, ii, 219
 of ectopic kidney, with pregnancy and labor, ii, 325
 of exfoliative cystitis following vaginismus, ii, 481
 of exfoliative cystitis relieved by postural treatment, ii, 482
 of exstrophy of bladder treated by Fowler's method, ii, 396
 of extirpation of urethra for carcinoma, ii, 597
 of fibroma of bladder in child, ii, 526
 of first successful operation for rupture of bladder, ii, 486

- Case, showing functional value of diseased kidney, compared with healthy fellow, i, 338
- of gigantism due to adrenal tumor, ii, 269
- of gun-shot wound of bladder, ii, 495
- of hematemesis with movable kidney, i, 498
- showing importance of fat in supporting kidney, i, 472
- of incontinence of urine cured by psychic treatment, ii, 560
- of intermittent cystic dilatation of ureter, ii, 359
- illustrating misleading nature of thickened ureter in venal tuberculosis, ii, 62
- of movable kidney following labor, i, 470
- in well-formed chest, i, 478
- of nephrectomy on one side with infected hydronephrosis on the other, i, 554
- of perirenal cyst communicating with renal pelvis, ii, 270
- of periurethritis chronica due to perforation of bladder by stem pessary, ii, 587
- of polycystic kidney with no symptom but tumor, ii, 278
- of prevesical abscess, ii, 502
- of pyelonephritis with sudden onset, ii, 220
- of pyonephrosis, due to ureteral stone, ii, 221
- with unusual complications, ii, 222
- illustrating rapid progress of renal tuberculosis, ii, 55
- of renal calculus passed spontaneously, ii, 110
- of rhabdomyoma of bladder in child, ii, 528
- of rhabdomyosarcomatosum of bladder in child, ii, 527
- of rupture of both kidneys, ii, 303
- of sarcoma, of bladder in boy, ii, 526
- of urethra in adult, ii, 598
- of sensory disturbance of bladder due to psychic influence, ii, 556
- of serous cyst of kidney with severe pain, ii, 275
- Case, of severe hemorrhage in renal tuberculosis, ii, 66
- of single ureter opening into female urethra, ii, 339
- of spontaneous gas formation in pneumaturia, i, 226
- of stricture of the ureter treated by dilatation, ii, 356
- of successful decapsulation of kidney for Bright's disease, ii, 292
- of successful operation for hypospadias in the female, ii, 568
- of suppurative inflammation of prevesical space, ii, 500
- of suture of bladder after rupture for first time, ii, 493
- of ureter prolapsed into bladder at vesical end, ii, 357
- of ureteral calculus removed transvesically, ii, 161
- of ureteral calculi with exstrophy of bladder, ii, 390
- of urethral myxosarcoma in patient three months old, ii, 598
- of urethral stricture treated by electrolysis, ii, 586
- of vesical diverticulum in man, ii, 375, 376
- operated on by Pousson's method, ii, 383
- of vesical hemorrhage from syphilis of bladder, ii, 484
- Cases, showing absence of results from medicinal treatment of renal tuberculosis, ii, 72
- showing anatomical results of suspension of kidney, i, 513, 514
- of angioma of bladder, ii, 525
- of anuria with renal calculus, ii, 112
- of continuous irrigation in tub for cystitis, ii, 469
- of cyst of vesical mucosa, ii, 514
- showing decreased excretion of indigo-carmin in bilateral renal infections, i, 320
- of double urethra, ii, 564
- showing duration of life in renal tuberculosis, ii, 71
- of essential hematuria and nephralgia, ii, 3, 8

- Cases, of exstrophy of bladder treated by implantation of ureteral orifices into rectum, ii, 400, 402
- of fibroma of urethra, ii, 593
- of fibromyxoma of bladder, ii, 520, 521
- of fissura vesicæ superior, ii, 403
- showing functional results of suspension of kidney, i, 516
- of gastro-intestinal symptoms with movable kidney, i, 487
- of gummata of the kidney, 187
- of headache with movable kidney, i, 493
- of heredity in polycystic kidney, ii, 276
- of hour-glass contraction of bladder, ii, 377
- of Maydl operation for exstrophy of bladder, ii, 399
- of movable kidney, with gall-bladder and liver disturbance, i, 491
- due to trauma, i, 478
- of operation for Bright's disease without decapsulation, ii, 290
- of pedunculate tumor of bladder, ii, 518
- of plastic operation for exstrophy of bladder, ii, 391, 392, 394
- of prevesical inflammation, ii, 499, 501
- of renal and ureteral calculus found by X-ray, ii, 132-136
- of renal calculus with double pelvis and ureter, ii, 126
- found by wax-tipped calculus, ii, 120
- of renal tuberculosis limited to one part of kidney, ii, 38, 40
- showing results from conservative operations for renal tuberculosis, ii, 84
- of retention of urine in hysterical patients, ii, 562
- of single ureter, opening into vagina, ii, 342
- opening into vestibule of vagina, ii, 343
- of "solitary" kidney, ii, 309
- of successful operation for epispadias, ii, 572, 573
- of supernumerary kidney, ii, 312
- of supernumerary ureter, opening into female urethra, ii, 339
- opening into vagina, ii, 342
- opening into vestibule of vagina, ii, 346
- Cases, of syphilis of bladder, associated with tabes, ii, 484
- of ureteral calculus, found by cystoscopic examination, ii, 118
- removed from pelvic floor, ii, 156
- removed from vesical end of ureter, ii, 159
- of urethral fibromyoma, ii, 592, 593
- of urethral myoma, ii, 591
- showing variations in function, in bilateral kidney disease, i, 343
- between diseased and healthy kidney, i, 341
- of normal kidneys, i, 339
- of vesical diverticulum in women, ii, 372
- Casts in urine, i, 211
- with renal calculus, ii, 116
- in renal tuberculosis, ii, 66
- Catarrh of urinary passages as basis of stone formation, ii, 101
- Cathelin's method of treatment for enuresis, ii, 561
- Catheter, shadow, in vesical diverticulum, ii, 379
- ureteral, i, 267
- wax-tipped, advantages of, i, 270; ii, 131
- in diagnosis of renal and ureteral calculus, ii, 120, 126
- in diagnosis of vesical calculus, ii, 170
- method of using, ii, 127
- retrograde use of, ii, 131
- use of, in male, ii, 131
- Catheterization of bladder, in diagnosis of hematuria, i, 223
- in diagnosis of pyuria, i, 218
- infection of urinary tract from, i, 234
- objections to, after rupture of bladder, ii, 490
- in retention of urine, ii, 563
- Catheterization of ureters, i, 267
- in cystitis, ii, 454
- in diagnosis, of hematuria, i, 223
- of hydronephrosis, i, 541
- of movable kidney, i, 500
- of pyonephrosis, ii, 221
- of pyuria, i, 218
- of renal and ureteral calculus, ii, 117
- in echinococcus disease of kidney, ii, 191
- in hydronephrosis, for relief of pain, i, 547

- Catheterization of ureters, injury follow-
ing, ii, 304
precautions in, i, 334
in pyelitis, ii, 206
renal insufficiency estimated by, i, 333
in renal tuberculosis, ii, 68
retrograde, ii, 131
safety of, i, 269
technique of, i, 270
in treatment of hydronephrosis, i, 547
uses of, i, 276
with water cystoscope, i, 298
- Cautery, actual removal of vesical tumors
by, ii, 534
- Cavities, formation of, in renal tuberculo-
sis, ii, 38
- Ceccherelli's incision, i, 380
- Cecum, dragging of, a cause of movable
kidney, i, 480
- Cells, yeast. See Yeast cells
- Centrifugalization in examination of urine
for tubercle bacillus, ii, 64
- Chart showing process under distention
treatment of cystitis, ii, 464
- Children, benign tumors of kidney in, ii,
263
 bilharziosis in, ii, 193
 carcinoma of kidney in, ii, 263
 cystitis in, ii, 480
 embryonic tumors of kidney in, ii, 262,
 263
 hypernephroma in, ii, 263
 malignant tumors of kidney in, ii, 239
 movable kidney in, i, 468, 470
 perirenal abscess in, ii, 232
 prolapse of urethra in, ii, 574
 pyelitis in, ii, 212
 renal calculus in, 98
 tuberculosis of kidney in, ii, 23
 ureteral calculus in, ii, 99
 urethral calculus in, ii, 183
 vesical calculus in, ii, 165
 vesical tumors in, ii, 526
- Chloroform, results following injection of,
into kidney, ii, 38
- Chromocystoscopy, i, 315
- Chyluria, ii, 201
 diagnosis of, ii, 202
 symptoms of, ii, 201
 treatment of, ii, 202
- Clinical studies, evidence afforded by,
on tuberculous infection through
ureter, ii, 30
- Cloaca, opening of ureter into, ii, 348
- Cocain anesthesia, in examination of blad-
der, i, 251
- Cocain injection, for enuresis, ii, 561
- Cocco-bacillus *aërogenes vesicæ*, in pneu-
maturia, i, 227
- Colic, renal. See Renal colic
- Collapse, due to rupture of kidney, ii, 298
- Collargol injections, as aid to X-ray, i, 349,
360; ii, 125
 in diagnosis of stricture of ureter, ii, 352
 pain following, i, 335
 use of, with X-ray in renal tuberculosis,
 ii, 70
- Colon, relation of, to left kidney, i, 71
 to right kidney, i, 66
- Colon bacillus, as cause of pyelitis in chil-
dren, ii, 212
 in pneumaturia, i, 227
 in renal infections, ii, 217
- Condylomata of bladder, ii, 188
- "Contracted bladder," definition of, ii, 477
 as sequel to cystitis, ii, 477
 treatment of, ii, 478
- Corsets, effect of, on vertebral column, i,
28
- Cortex of kidney, arteries to, i, 161
 structure of, i, 153
 veins of, i, 162
- Crest of ilium, relation of, to kidney, i, 38
- Cryoscopy, of the blood, i, 305
 of the urine, i, 310
- Cull's albuminuria, i, 206
- Cullen cystoscope, i, 279
- Cultural methods of diagnosis in renal
tuberculosis, ii, 67
- Curettage for cystitis, ii, 465
- Cushny and Loewi's experiments on poly-
uria in anemia, i, 188
- Cystitis, ii, 443
 avenue for infection in, ii, 444
 bacteria causing, i, 231, 232, 233, 234;
 ii, 445, 458
 catheterization of ureters in, ii, 454
 in children, ii, 480
 cicatrices due to, ii, 475
 conditions predisposing to, ii, 443

- Cystitis, contracted bladder as sequel of, ii, 477
 curettage for, ii, 465
 cystoscopic examination for, ii, 452
 definition of, ii, 443
 diagnosis of, ii, 450
 differential diagnosis of, ii, 455
 drainage by urethra in, ii, 466
 drainage by vesico-vaginal incision in, ii, 466
 elimination of renal infection in, ii, 459
 etiology of, ii, 443
 excision of diseased area for, ii, 471
 exfoliative, ii, 480
 definition of, ii, 480
 diagnosis of, ii, 482
 etiology of, ii, 481
 symptoms of, ii, 481
 treatment of, ii, 482
 general principles of treatment for, ii, 456
 hygienic treatment of, ii, 459
 installations for, ii, 462
 irrigations for, ii, 461
 lesions characteristic of, ii, 445, 453
 medication in treatment of, ii, 459
 organisms causing, ii, 458
 pathology of, ii, 445
 progressive distentions for, ii, 463
 sequestration of diseased area for, ii, 474
 summary of treatment for, ii, 476
 suppurativa exfoliata. See Cystitis, exfoliative
 symptoms of, ii, 449
 topical treatments of, ii, 465
 treatment of, ii, 456
 acute, ii, 457
 based on form of infection, ii, 458
 chronic, ii, 458
 tub treatment for, ii, 468
 vesical ulcer as complication of, ii, 479
 Cystopyelitis, as sequel to rupture of kidney, ii, 297
 Cystoscope, air. See Air cystoscope
 Albarran type of catheterizing, i, 290
 Baer's, i, 285, 290
 Braasch, i, 289
 Bransford-Lewis, i, 285, 289, 294, 298
 Brenner, i, 285, 290
 Brenner type of catheterizing, i, 285, 290
 Cystoscope, Brown-Buerger, i, 285, 289, 293, 298
 Cullen, i, 279
 employment of, in indigo-carmin test, i, 315
 ideal, i, 285
 Kelly, i, 277
 Kollmann, i, 285, 289, 292, 294
 lithotrite combined with, i, 290
 modifications of Kelly, i, 277
 Nitze. See Water cystoscope
 open-air. See Cystoscope, air
 panoptic, i, 290
 photographic, i, 292
 Schluginweit, i, 285, 289
 stereoptical, i, 292
 water. See Water cystoscope
 Cystoscopes, i, 277
 catheterizing, i, 289
 operative, i, 290
 source of electricity for lighting, i, 294
 for special uses, i, 292
 Cystoscopic examination. See Cystoscopy
 Cystoscopy, in cystitis, ii, 451, 452
 in diagnosis, of movable kidney, i, 500
 of renal injuries, ii, 300
 of ureteral calculus, ii, 118
 of vesical calculus, ii, 170
 of vesical diverticulum, ii, 377, 378, 381
 of vesical tumor, ii, 530
 direct method of, i, 248
 in echinococcus disease of kidney, ii, 191
 in hematuria, i, 223
 in hydronephrosis, i, 539
 ideal conditions for, i, 289
 in litholapaxy, ii, 176
 of male bladder, i, 277
 method of, by air cystoscope, i, 248
 by water cystoscope, i, 284
 after operation for vesical calculus, ii, 176
 in operation for vesical calculus, ii, 170
 in pneumaturia, i, 226
 position of patient in, i, 277
 by water cystoscope, i, 296
 in pyelitis, ii, 206
 in pyonephrosis, ii, 221
 in pyuria, i, 218
 in renal tuberculosis, ii, 67
 of rudimentary kidney, ii, 311

- Cystoscopy, by water cystoscope, i, 284, 294
 in vaginal operation for vesical calculus, ii, 179
- Cystotomy, suprapubic extraperitoneal, ii, 538
 suprapubic transperitoneal, ii, 546
- Cystic kidney. See Kidney, cystic
- Cysts, of kidney, ii, 271
 classification of, ii, 271
 dermoid, ii, 272
 formation of, with renal calculi, ii, 105
 mortality following nephrectomy for, ii, 275
 retention in, ii, 272
 sequel to rupture of kidney, ii, 297
 sero-hemorrhagic, ii, 272
 serous, ii, 272
 treatment of, ii, 275
 of vesical mucosa, ii, 514
- Czerny's incision, i, 380
- D'Antona's incision, i, 381
- Davidson bulb syringe, use of, in suprapubic section for vesical calculus, ii, 181
- Decapsulation of kidney, history of, ii, 289
 for nephralgia, ii, 3, 8
- Denudation of vesicovaginal fistula, ii, 414
- Dermoid cysts, of bladder, ii, 517
 of kidney, ii, 272
- Detrusor muscle of bladder, i, 196
- Diabetes, pancreatic, association of, with movable kidney, i, 494
 characteristics of urine in, i, 188
- Diabetes insipidus, action of central nervous system in, i, 190
- Diabetes mellitus, association of, with pneumaturia, i, 227
- Diaphragm, anatomical relations of, i, 30
 conditions favoring hernia of, i, 31
 nerve supply of, i, 30
 in relation to lumbar region, i, 30
- Diaphragmatic hernia, conditions favoring, i, 31
- Dickinson's syringe, use of, in cystitis, ii, 463
- Diet, in acute pyelonephritis, ii, 223
 after operations on kidney, i, 417
 in essential hematuria, ii, 7
- Diet, in treatment of renal and ureteral calculus, ii, 137
- Dietl's crisis, in movable kidney, i, 460
 origin of term, i, 460
- Dilatation, gradual, for chronic urethritis, ii, 581
 treatment of urethral stricture by, ii, 586
 rapid, treatment of urethral stricture by, ii, 586
- Distentions, progressive, for cystitis, ii, 463
- Distoma hematobium, ii, 193
- Diverticula, containing urethral calculi, ii, 185
 of pelvis, i, 149
 vesical, ii, 168
- Diverticulum, vesical, ii, 372
 comparative frequency of, in sexes, ii, 372
 definition of, ii, 372
 demonstration of, by X-ray, i, 368
 diagnosis of, ii, 376
 etiology of, ii, 375
 literature of, ii, 384
 occurrence of, ii, 372
 operation for, ii, 380
 recognition of, ii, 170
 removal of sac in operation for, ii, 382
 rubber balloon in operation for, ii, 382
 symptoms of, ii, 375
 treatment of, ii, 379
- Dorsal position, elevated, for inspection of bladder, i, 249
- Drainage, continuous, for exfoliative cystitis, ii, 483
 after intracapsular enucleation of kidney, ii, 154
 after operation for Bright's disease, ii, 294
 for enterovesical fistula, ii, 406
 on kidney, i, 416
 for rupture of bladder, ii, 494
 for vesico-cervico-vaginal fistula, ii, 419
 for vesico-vaginal fistula, ii, 417
 after suprapubic section, ii, 183
 of bladder, ii, 183
 after uretero-ureteral anastomosis for ureteral fistula, ii, 438
 by urethra, for cystitis, ii, 466

- Drainage, by vesico-vaginal incision in cystitis, ii, 466
- Dressing, after operations on kidney, i, 416
- Drugs, in actinomycosis, ii, 201
 in acute cystitis, ii, 457, 458
 in acute urethritis, ii, 579
 in chronic cystitis, ii, 460
 in control of hemorrhage from injury to kidney, ii, 301
 in enuresis, ii, 561
 influence of, on renal secretion, i, 186
 in pneumaturia, i, 225
 in syphilis of bladder, ii, 484
 in treatment of renal and ureteral calculus, ii, 137
- Du Bose colorimeter, i, 321
- Dudley's operation, for extensive vesical fistula, ii, 426
- Dulness, area of, due to rupture of kidney, ii, 299
- Duodenum, relation of right kidney to, i, 63
- Duret's incision, i, 380
- Dysuria. See Urination, frequent
- Echinococcus cyst, pressure by, a cause of hydronephrosis, i, 528
- Echinococcus disease, ii, 188
 of kidneys, ii, 189
 age in relation to, ii, 189
 diagnosis of, ii, 190
 pathological anatomy of, ii, 189
 prognosis of, ii, 191
 in sexes, ii, 189
 symptoms of, ii, 190
 treatment of, ii, 191
- Ectopia vesicæ. See Exstrophy of bladder
- Ectopic kidney, ii, 321, 322
- Edebohls bag, in nephrectomy for renal tuberculosis, ii, 76
 in operation, for Bright's disease, ii, 293
 for hydronephrosis, i, 548
 on kidney, i, 386
 in renal operations in general, i, 386
 in suspension of kidney, i, 508
- Edebohls' incision, i, 381
- Edema of leg, with movable kidney, i, 493
- Edison lamp, in cystoscopy, i, 286
- Electric light, in examination of bladder, i, 253
- Electricity, for incontinence of urine, ii, 560
 in sensory disturbances of the bladder, ii, 555
 source of, for lighting cystoscopes, i, 294
- Electrolysis, treatment of urethral stricture by, ii, 586
- Embryonic tumors of kidney, ii, 262
 age, in relation to, ii, 262
 definition of, ii, 262
 mortality from, ii, 264
 pathological anatomy of, ii, 263
 symptoms of, ii, 264
 treatment of, ii, 264
- Enteroptosis, association of, with movable kidney, i, 487
- Entropionizing, ii, 439
- Enuresis, ii, 560
 treatment of, ii, 561
- Epidural injections in treatment of incontinence of urine, ii, 561
- Epispadias, ii, 568
 forms of, ii, 568
 treatment of, ii, 568
- Epithelial cells, significance of, in urine, i, 211
- Epithelioma, papillary, of renal pelvis and ureter, ii, 255
 of renal pelvis and ureter, ii, 262
 of ureter, ii, 262
- Ergot, use of, in essential hematuria, ii, 7
- Erlanger blood-pressure machine, i, 206
- Esbach's reagent, i, 208
- Ether, as anesthetic in renal operations, i, 379
 results following injection of, into kidney, ii, 33
- Excretory apparatus, types of, in vertebrates, i, 75
- Experimental polyuria test, for renal insufficiency, i, 336
- Experiments, by Claude Bernard on albuminuria following injury to brain, i, 208
 on production of reflex anuria, ii, 112
 on relation of blood pressure to renal secretion, i, 183
 on renal secretion, i, 181
- Exstrophy of bladder, ii, 385
 choice of operation for, ii, 390

- Exstrophy of bladder, classification of operations for, ii, 390**
 clinical features of, ii, 388
 definition of, ii, 385
 mortality from, ii, 389
 mortality following Maydl operation for, ii, 400
 operation for, by implantation of ureters into bowel, ii, 396
 plastic operations for, ii, 390, 391
 treatment of, ii, 389
Extraperitoneal incision, in nephrectomy for renal tuberculosis, ii, 76
Fallopian tube, opening of ureter into, ii, 347
 puncture of, in suspension of kidney, i, 508
Fascia iliaca, i, 9
Fascia lumbo-dorsalis, i, 7
Fascia perirenalis, i, 463
Fascia rectovesical, ii, 363
Fascia renalis, i, 50, 56
Fascia superficialis, i, 8
Fat, pararenal. See Pararenal fat
 rapid absorption of, a cause of movable kidney, i, 471
 retroperitoneal. *See* Pararenal fat
Fattening, in treatment of movable kidney, i, 503
Fatty capsule, treatment of, in suspension of kidney, i, 513
Fatty sclerotic kidney. See Kidney, fatty sclerotic
Fenwick's rules for interpretation of radiograms, of renal calculus, i, 352, 357, 360
 of ureteral calculus, i, 362
Fetus, lobulation of kidney in, i, 129
 spinal curves of, i, 28
Fever. See Temperature, elevation of
Fibroma, of bladder, ii, 522
 of renal parenchyma, ii, 237
 of urethra, ii, 591
Fibromyoma of urethra, ii, 591
Fibromyxoma of bladder, ii, 520
Filaria sanguinis hominis, ii, 201
Fissura vesicæ superior, ii, 403
Fistula, entero-vesical, definition of, ii, 404
Fistula, entero-vesical, etiology of, 404
 diagnosis of, ii, 405
 treatment of, ii, 405
 recto-vaginal, ii, 434
 recto-vesical, ii, 407
 ureteral, ii, 435
 conditions influencing operation for, ii, 436
 etiology of, ii, 435
 operation for, ii, 437
 uretero-vaginal, ii, 439
 urethral, ii, 441
 with stricture of urethra, ii, 585
 urethro-vaginal. *See* Fistula, urethral
 utero-vesical. *See* Fistula, vesico-uterine
 vesical, ii, 404
 adherent to pubic rami, ii, 431
 close to perineum, ii, 433
 complicated by pyonephrosis, ii, 435
 complicated by rupture of symphysis, ii, 413
 complicated by torn perineum, ii, 434
 complications of, ii, 423
 definition of, ii, 404
 inaccessible, ii, 427
 minute, ii, 426
 multiple, ii, 427
 preliminary treatment for, ii, 424
 with stricture of urethra, ii, 585
 ureters in margin of, ii, 433
 varieties of, ii, 404
 very large, ii, 424
 vesico-cervico-vaginal, ii, 418
 vesico-urethro-vaginal, ii, 421
 vesico-uterine, ii, 420
 vesico-cervico-vaginal, ii, 418
 vesico-genital, classification of, ii, 412
 complications of, ii, 423
 vesico-hypogastric, ii, 404
 vesico-urethro-vaginal, ii, 421
 vesico-uterine, ii, 420
 treatment of, ii, 428
 vesico-vaginal, anesthesia in, operation for, ii, 413
 apparatus for collecting urine leaking from, ii, 422
 complications of, ii, 423
 conditions necessary to success in operation for, ii, 413
 definition of, ii, 404

- Fistula, vesico-vaginal**, diagnosis of, ii, 411
 etiology of, ii, 407
 following drainage by vesical incision for cystitis, ii, 467
 formation of, for tuberculosis of bladder, ii, 87
 position of patient in, operation for, ii, 413
 post-operative treatment for, ii, 417
 sutures in closure of, ii, 415
 symptoms of, ii, 410
 treatment of, ii, 411
 varieties of, ii, 412
- Five-plate method of X-ray examination**, i, 349
- Folin's method**, for determining acidity of urine, i, 210
- Foreign bodies as nuclei for formation of vesical nuclei**, ii, 166
- Formalin**, irrigation with, in pyelitis, ii, 210
 tests for liberation of, ii, 207, 210
- Formalin injections**, in echinococcus disease of kidney, ii, 192
- Formula**, for determining specific gravity of urine, i, 275
- Fornices, renal**, development of, i, 118
 number of, i, 122
 relation between, and surface of kidney, i, 122
- Fowler's operations for exstrophy of bladder**, ii, 396
- Freezing point of blood**, i, 305
 lowering of, in renal insufficiency due to calculus, ii, 115
 of solutions, symbol for, i, 310
 of urine, i, 193, 310
- Freund and Rosthorn's operation for extensive vesical fistula**, ii, 425
- Frying-pan incision**, i, 404
- Functional tests**, for renal incapacity, combination of, i, 335
 dependent on examination of blood, 304
 for renal insufficiency, apparatus for use in, i, 317
 dependent on examination of urine, i, 307
 dependent on excretion of foreign substances, i, 312
- Functional tests**, in diagnosis of perirenal abscess, ii, 234
 in diagnosis of renal and ureteral calculus, ii, 123
 disagreeable sequelæ to, i, 334
 estimation of kidneys separately by, i, 334
 experimental polyuria and, i, 336
 as guide to removal of kidney, i, 338
 in hydronephrosis, i, 542
 ideals of, i, 301
 possibilities of, i, 303
 precautions necessary in, i, 334
 value of, in renal tuberculosis, ii, 70
- Funnel-shaped ureter**, ii, 68
- Gall-bladder**, disturbance of, associated with movable kidney, i, 490
- Gartner's duct**, opening of ureter into, ii, 347
- Gas**, presence of, in urine. See Pneumaturia
- Gastro-intestinal tract**, disturbance of, with movable kidney, i, 487
 with renal calculus, ii, 111
- Geographical locality**, influence of, on renal calculus, ii, 99
- Gersuny's operation for exstrophy of bladder**, ii, 398
- Giantism**, due to adrenal tumor, ii, 269
- Girdled kidney**, ii, 51
- Girls**, prolapse of urethra in, ii, 577
- Gland extracts**, in enuresis, ii, 561
 in retention of urine, ii, 563
- Glomerulus**, microscopic structure of, i, 154
 reabsorption of filtrate from, i, 187
- Glycosuria**, i, 210
- Goetzl's experiments on production of reflex anuria**, ii, 112
- Golf-hole ureter**, ii, 68
- Goniometer**, i, 263
- Gonococcus**, in nuclei of renal calculi, ii, 99
 renal abscess due to, ii, 217
- Gonorrhea**, associated with vesical neuroses, ii, 354, 355
 stricture of urethra due to, ii, 585
- Gravel**, with renal calculus, ii, 115
- Gridiron incision**, i, 386, 398

- Guinea-pig method, in urinary examination for tubercle bacillus, ii, 65
- Gummata of kidney, ii, 187
- Gunshot wounds, of bladder, ii, 495
- Hahn's incision, i, 380
- Hair-pin speculum. See Speculum
- Harrington-Mayo operation, for vesical tumor, ii, 346
- Headaches, with movable kidney, i, 493
- Head-mirror, in examination of bladder, i, 253
- Heidenhain's experiments, on renal secretion, i, 181
- Heidenhain's theory, of renal secretion, i, 176
- Hematemesis with movable kidney, i, 493, 494
- Hematuria, i, 218
 - albuminuria associated with, i, 221
 - appearance of blood in, i, 221
 - associated with hydronephrosis, i, 537
 - *Bright's disease as cause of, i, 224
 - in embryonic tumors of kidney, ii, 264
 - essential, ii, 1
 - diagnosis of, ii, 6
 - diagnosis between, and malignant tumor of kidney, ii, 282
 - etiology of, ii, 2
 - expectant treatment for, ii, 6
 - history of, ii, 1
 - lactation associated with, ii, 4
 - nephritis as cause of, ii, 2
 - operation for, ii, 7
 - pathology of, ii, 2
 - pregnancy associated with, ii, 4
 - symptomatology, ii, 5
 - treatment of, ii, 6
 - estimation of red blood cells in, i, 222
 - frequency of, i, 219
 - general considerations as to, i, 223
 - idiopathic renal. See Hematuria, essential
 - as indication for operation in malignant tumor of kidney, ii, 282
 - in malignant disease of kidney, ii, 248
 - physical changes in urine due to, i, 221
 - physical examination for, i, 223
 - with renal calculus, ii, 110, 115
 - in renal tuberculosis, ii, 59
- Hematuria, due to rupture of kidney, ii, 298
 - with serous cysts of kidney, ii, 275
 - sources of blood in, i, 220
 - as symptom of malignant tumor of kidney, ii, 281, 282
 - as symptom of vesical calculus, ii, 169
 - symptoms pointing to source of blood in, i, 222
 - treatment of, i, 224
 - with ulcer of bladder, ii, 479
- Hemoglobin in urine. See Hemoglobinuria
- Hemoglobinuria, i, 228
- Hemorrhage, internal, after rupture of kidney, ii, 299
 - renal, Bright's disease a cause of, i, 224
 - death due to, i, 206; ii, 5
 - due to lesions of kidney, i, 220
 - in nephrolithotomy, i, 443
 - due to rupture of kidney, ii, 297, 299
 - sources of, in renal operations, i, 220
 - as symptom of vesical tumor, ii, 529
 - with vesical diverticulum, ii, 375
- Henle, loop of, i, 179
- Heredity, influence of, on enuresis, ii, 560
 - in urinary disorders, i, 369
- Hermann's experiments, on solids in urine after ligation of ureter, i, 189
- Hernia, diaphragmatic, conditions favoring, i, 31
 - inguinal, with exstrophy of bladder, ii, 386
- Hexamethylenamin. See Urotropin
- High frequency current, vesical tumor removed by, ii, 534
- Histological studies of kidney, i, 181
- History-taking, value of, in urinary disorders, i, 369
- Horseshoe kidney, arteries of, ii, 314
 - causes of, i, 93; ii, 313
 - frequency of, ii, 318
 - fusion of, 315
 - pain caused by, ii, 336
 - rupture of, ii, 296
 - X-ray in diagnosis of, i, 360
- Hydatid cyst of kidney, ii, 189
- Hydatid disease of bladder, ii, 192
- Hydremia, character of urine during, i, 185
- Hydrogen peroxid, capacity of blood to catalyze, i, 306

- Hydronephrosis, i, 520
 abnormal mobility of kidney a cause of, i, 525, 530
 acquired, causes of, i, 526, 532
 aspiration of sac in, i, 547
 due to bilharziosis, ii, 195
 catheterization of ureters in diagnosis of, i, 541
 for relief of pain, i, 547
 congenital causes of, i, 523
 conservative operations for, i, 550
 cystoscopy in, i, 539
 definition of, i, 520, 554
 diagnosis of, i, 539
 etiology of, i, 520
 function of kidney affected by, i, 544, 554
 functional tests for, i, 542
 infection in, i, 537
 influence of position upon, i, 532, 537
 following injury to ureter, ii, 305
 movable kidney associated with, i, 482
 movable kidney a cause of, i, 482
 pain in, i, 536
 palliative measures in, i, 546
 pathological anatomy of, i, 533
 plastic operations for, i, 552, 555
 prognosis in, i, 544
 radical operations for, i, 548
 relative frequency of, on two sides, i, 520
 due to renal calculus, ii, 105, 125
 resection for, i, 553
 secondary to renal tuberculosis, ii, 45
 as sequel to rupture of kidney, ii, 297
 symptomatology, i, 536
 treatment of, i, 545
 urinary examination in, i, 539
 due to vesical diverticulum, ii, 375
 X-ray in diagnosis of, i, 361, 544, 550
- Hypernephroma, ii, 251
 X-ray in diagnosis of, i, 360
- Hypogastric bladder, influence of, on bladder, i, 201
- Hypospadias, ii, 565
 symptoms of, ii, 565
 treatment of, ii, 565
- Hysteria, hematuria associated with, ii, 4
 retention of urine associated with, ii, 562
- Incision, Abbe's, i, 381
 abdominal, in suprapubic section, ii, 181
 Albarran's, i, 381
 Bardenheuer's, i, 380
 barn-door, i, 406
 v. Bergmann's, i, 380
 Ceccherelli's, i, 380
 closure of abdominal, after kidney operation, i, 415
 in suprapubic section, ii, 182
 Czerny's, i, 380
 D'Antona's, i, 381
 for decapsulation of kidney in Bright's disease, ii, 293
 Duret's, i, 380
 Edebohls', i, 381
 for exposure of renal calculus, ii, 139, 145
 for extensive renal operations, i, 398
 extraperitoneal in nephrectomy for renal tuberculosis, ii, 76
 frying-pan, i, 404
 gridiron, i, 386, 398
 Hahn's, i, 380
 Johnson's, i, 383
 Keen's, i, 381
 König's, i, 383
 Küster's, i, 380
 lumbar, i, 384
 in nephrectomy for renal tuberculosis, ii, 76
 M'Ardle's, i, 382
 McBurney's, 382
 Morris', i, 382
 in nephrectomy for malignant disease of kidney, ii, 284
 in operation for vesical diverticulum, ii, 382
 Pean's, i, 381
 for perineal section, ii, 177
 Poncet's, i, 380
 in pyelotomy, i, 441
 for renal tumors, i, 404, 407
 retroperitoneal, i, 384
 Robson's, i, 382
 for silver wire method of nephrotomy, i, 450, 452
 Simon's, i, 379
 suprapubic, into bladder, ii, 182
 for gunshot wounds of bladder, ii, 495

- Incision, suprapubic, for rupture of bladder, ii, 493
 for suspension of kidney, i, 506, 508
 Tillmann's, i, 382
 of urethral stricture, ii, 586
- Incision and drainage, for echinococcus disease of kidney, ii, 192
- Incisions, in minor operations on kidneys, i, 386
 for nephrolithotomy, i, 443
 for nephro-ureterectomy, i, 407
 principle of renal, i, 445
 transverse nephrotomy, i, 457
 for exposure of kidney, arteries encountered in, i, 16
 lumbar fascia in, i, 8
 for exposure of kidney and ureter, i, 379
 relations of, to nature of operation, i, 385
 topography of lumbar region in relation to, i, 384
- Incontinence of urine, ii, 557
 due to abnormal opening of ureter, ii, 337
 non-operative treatment of, ii, 559
 operations for, ii, 558
 in renal tuberculosis, ii, 58
 in children, ii, 24
 as symptom of urinary diseases, i, 373
 types of, ii, 557
- Index, Becher and Lennhoff's, i, 475
- Indigo-carmin test, experimental facts concerning, i, 317
 experiments with, on renal secretion, i, 181
 before nephrectomy for injury to kidney, ii, 303
 personal observations on, i, 320
 for renal insufficiency, i, 315
 technique of, i, 316
 time required for, i, 318
- Infarcts, infected, of kidney, ii, 216
 renal form of, i, 430
 in healing of nephrotomy wounds, i, 456
- Infection, avenue of, in actinomycosis, ii, 197
 in bilharziosis, ii, 193
 in disease of urinary tract, 233
 in echinococcus disease, ii, 189
 in kidney and ureter, ii, 217
- Infection, avenue of, in pyelitis, ii, 203
 perirenal. See Perirenal infection
 secondary, in renal tuberculosis, ii, 42
 treatment of cystitis based on form of, ii, 458
- Infections of kidney. See Renal infections
- Infectious diseases, acute bacteriuria in, i, 234
- Inflammations, perirenal. See Perirenal inflammations
- Injuries, to bladder and urethra, ii, 496
 classification of, ii, 489
 diagnosis of, ii, 490
 early knowledge of, ii, 486
 from gunshot wounds, ii, 495
 incomplete rupture of bladder, ii, 495
 literature of, ii, 487
 proportion of, in sexes, ii, 486
 sequelæ to, ii, 489
 with sharp or blunt instrument, ii, 494
 treatment of, ii, 492
- to kidney, ii, 296
 diagnosis of, ii, 300
 expectant treatment for, ii, 301
 hematuria due to, i, 220
 indications for operation for, ii, 301
 renal arteries in relation to, i, 432
 rupture, ii, 296
 stab or gunshot wounds, ii, 303
 subcutaneous, ii, 296
 treatment of, ii, 300
 varieties of, ii, 296
- to ureter, ii, 303
 from bullet or stab wounds, ii, 306
 diagnosis of, iii, 306
 etiology of, ii, 303
 treatment of, ii, 306
- Inspection, of bladder, i, 248
 with water cystoscope, i, 297
 in cystitis, ii, 451
 in examination of urinary tract, i, 242
 of ureter, i, 243
 of urethra, i, 243
- Instillations, in cystitis, ii, 462
- Instruments, for examination of bladder, i, 251
 for examination of urinary tract, i, 244, 251
 in operation for vesico-vaginal fistula, ii, 414

- Instruments, preparation of, for renal operations, i, 378
- Intestine, large, relation of kidneys to, i, 39
- small, relation of, to left kidney, i, 71
- Intoxications, general, hematuria due to, i, 220
- Intra-abdominal pressure, influence of, on emptying of bladder, i, 201
- mobility of kidney affected by, i, 465
- Intracapsular enucleation for renal calculus, ii, 153
- Intrapelvic organs, hydronephrosis due to pressure of, i, 528, 551
- Iodid of silver injection, in X-ray examination for vesical diverticulum, ii, 379, 381
- Irrigation, of bladder, for exfoliative cystitis, ii, 483
- after suprapubic section, ii, 183
- after vaginal operation for calculus, ii, 180
- continuous, for vesical fistula, ii, 424
- exfoliative cystitis treated by, ii, 483
- after operation for vesico-vaginal fistula, ii, 417
- in pyelitis, ii, 210
- Irrigations, in cystitis, ii, 461
- Irritability of bladder, in renal tuberculosis, ii, 58
- due to renal calculus, ii, 111
- "Irritable bladder," ii, 555
- diagnosis between, and cystitis, ii, 455
- Ischial triangle, i, 363
- Israel's method of palpation for movable kidney, i, 497
- Jaboulay's method of treatment for enuresis, ii, 561
- Jaundice with movable kidney, i, 491
- Jews, liability of, to renal calculus, ii, 99
- Johnson's incision, i, 383
- Jolles' test for albumin, i, 205
- Keen's incision, i, 381
- Kehldorf method, i, 308
- Kelly cystoscope, modifications of, i, 277
- Kelly method, for suspension of kidney, i, 508
- Kelly's operation, for incontinence of urine, ii, 558
- for vesical diverticulum, ii, 380
- Kidney, actinomycosis of. See Actinomycosis
- adenoma of. See Adenoma of kidney
- amount of blood passing through, i, 184
- in relation to renal secretion, i, 183
- anatomy of, i, 127
- attachment of, to adrenal gland, i, 465
- to pancreas, i, 465
- atrophy of, ii, 310
- axes of, i, 45
- belted. See Belted kidney
- blood-vessels of, i, 179
- carcinoma of. See Carcinoma
- connective tissue of, i, 165
- conservative operations upon, in renal tuberculosis, ii, 83
- consistency of, i, 139
- contour and form of, influenced by rotation, i, 133
- cortical substance of, i, 153
- cystic secondary to renal tuberculosis, ii, 45
- cysts of. See Cysts of kidney
- decapsulation of. See Decapsulation of kidney
- development of permanent, i, 82
- vascular system in, i, 93
- displaced. See Kidney, movable
- echinococcus disease of. See Echinococcus disease
- ectopic, i, 322; ii, 32
- embryonic tumors of. See Embryonic tumors of kidney
- enlargement of, as diagnostic sign, i, 370
- exposure of, in renal operations, i, 15
- fatty sclerotic, secondary to renal tuberculosis, ii, 45
- fetal stage of, early, i, 82
- later, i, 109
- floating, definition of, i, 459
- form and axis of, i, 127
- form of, influenced by first ureteral division, i, 129
- influenced by rotation, i, 130
- function of, i, 174
- affected by hydronephrosis, i, 544, 554
- girdled. See Girdled kidney

Kidney, gummata of, ii, 187

Heidenhain's experiments on, i, 181

hematuria due to lesions of, ii, 220

hemorrhage from. See Hemorrhage, renal

histological studies of, i, 181

horseshoe. See Horseshoe kidney

hydatid cysts of, ii, 189

incisions for exposure of. See Incisions

infected infarcts of. See Infarcts, infected

infections of. See Renal Infections

injuries to. See Injuries to kidney

internal secretion by, i, 175

intra-abdominal pressure in relation to mobility of, i, 465

landmarks on surface of, in nephrotomy, i, 437

lavage of, ii, 210

left, exposure of, i, 62

in pyelitis, ii, 210

relation of, to descending colon, i, 71

to pancreas, i, 69

to spleen, i, 43, 69

to splenic flexure of colon, i, 70

to stomach, i, 67

lobulated fetal, ii, 312

lobulation of, in fetus, i, 129

as guide in nephrotomy, i, 438

in relation to mobility of, i, 482

lump, ii, 321

lymphatics of, i, 164, 180

macroscopic anatomy of, in relation to secretion, i, 177

macroscopic structure of, i, 150

maldevelopment of. See Maldevelopment of kidney

medullary substance of, 152

method of obtaining urine from, without catheterization, i, 263, 267

microscopic structure of, i, 154

mobility of, i, 461

movable, i, 459

age in relation to, i, 467

anatomical facts concerning, i, 460

appendical symptoms with, i, 492

bladder symptoms associated with, i, 499

catheterization of ureters in diagnosis of, i, 500

Kidney, movable, in children, i, 468, 470

congenital predisposition to, i, 480

cystoscopic examination in diagnosis of, i, 500

definition of, i, 459

degrees of, i, 495

diagnosis of, i, 494, 501

dilatation of stomach a cause of, i, 481, 489

displacement of aorta and vena cava in operation for, i, 396

dragging of cecum as cause of, i, 480

early surgery of, i, 460

etiology of, i, 469

frequency of, i, 466

gall-bladder and liver, symptoms associated with, i, 490

gastro-intestinal symptoms associated with, i, 487

history of, i, 459

hydronephrosis associated with, i, 482

hydronephrosis caused by, i, 525, 530

index of, from body form, i, 475

injection of renal pelvis in diagnosis of, i, 498, 500

menstruation in relation to, i, 480, 485, 493

nervous symptoms with, i, 489

non-operative treatment for, i, 502

normal position of kidney in relation to, i, 460

occurrence of, i, 466

operative treatment for, i, 504

pain in, i, 485

palpation of, i, 242

pathology of, i, 482

peculiar body form a cause of, i, 474

pelvic symptoms associated with, i, 492

percussion for, i, 498

physical examination for, i, 494

pregnancy and labor as cause of, i, 470

prophylaxis against, i, 502

ptoses of other organs, associated with, i, 468

rapid absorption of fat a cause of, i, 471

relation of adrenal bodies to, i, 74

renal calculus as cause of, i, 470

renal tumors as cause of, i, 470

Kidney, movable, as sequel to rupture of
 kidney, ii, 297
 sex in relation to frequency of, i, 466
 summary of results from treatment of,
 i, 518
 suspension for relief of, i, 504. See
 also Kidney, suspension of
 symptomatology of, i, 484
 tight lacing as cause of, i, 472
 traction exerted by, on duodenum, i,
 66
 trauma as cause of, i, 478
 treatment of, i, 501
 unusual symptoms with, i, 493
 urinary examination in diagnosis of, i,
 499
 variety of motion in, i, 495
 X-ray in diagnosis of, i, 360, 499
multiple abscesses of. See Abscesses,
 multiple
nerves of, i, 165, 180
new growths of. See Tumors of kidney
normal mobility of, i, 461
normal position of, i, 460
operations on. See Operations on kid-
 ney
pain in, as means of diagnosis, i, 371
palpation of, i, 242
 for renal calculus, ii, 116
 in renal tuberculosis, ii, 61
pelvis of, i, 139. See also Pelvis, renal
peritoneal coat of, i, 463
peritoneal folds of, i, 463
physiology of, i, 174
polycystic. See Polycystic kidney
post-fetal stage of growth in, i, 117
pus in. See Pyuria
relation of pelvis to surface of, i, 119
relative weight of, in newborn and in
 adult, i, 92
resection of, i, 430
 for renal tuberculosis, ii, 83
right, relation of, to colon, i, 66
 to duodenum, i, 63
 to liver, i, 67
rotation of, 88
 in relation to vascularization, i, 133
rudimentary, ii, 310
rupture of, ii, 296
 diagnosis of, ii, 300

Kidney, rupture of, diagnosis between, and
 rupture of bladder, ii, 491
 expectant treatment for, ii, 301
 sequelæ to, ii, 296
 symptoms of, ii, 297
 treatment of, ii, 300
sarcoma of. See Sarcoma of kidney
scutiform, ii, 320
secretion of. See Renal secretion
shape of, i, 122
shield-shaped. See Kidney, scutiform
sigmoid, ii, 320
simple elongated, ii, 319
site of selection for tuberculous infection
 of, ii, 32
size of, i, 122, 137
 in relation to its delivery, i, 410
solitary, ii, 309
stone in. See Calculus, renal
structure of, i, 150
 supporting, i, 462
subcutaneous injury of, ii, 296
surface of, in relation to structure, i,
 437
surgical anatomy of, with reference to
 nephrotomy and resection, i, 418
suspension of, i, 504
 anatomical results of, i, 513
 decapsulation of kidney in, i, 507
 exposure of kidney in, i, 509
 first lumbar nerve in relation to, i,
 390
 for hydronephrosis, i, 550
 functional results of, i, 515
 history of, i, 504
 incisions for, i, 506, 508
 Kelly method for, i, 508
 level of fixation for, i, 506
 methods for, i, 504
 mortality following, i, 515
 placing of sutures in, i, 512
 position of patient in, i, 508
 post-operative complications to, i, 515
 post-operative treatment for, i, 517
 puncture of fascia in, i, 508
 skin incision for, i, 508
 summary of results of, 518
 sutures employed in, i, 506, 507
 technique of, i, 508
 treatment of fatty capsule in, i, 513

- Kidney, symptoms connected with, in urological diagnosis, i, 370
 syphilis of, ii, 187
 theories regarding secretion by, i, 176
 tissue of, i, 151
 topography of, from within, i, 42
 tuberculosis of. See Tuberculosis of kidney
 tumors of. See Tumors of kidney
 typical forms of, i, 131
 unilateral elongated, ii, 319
 unsymmetrical, ii, 309
 vascular channels to, i, 160
 vascular pedicle of, i, 465
 veins of, i, 99
 weight of, i, 137
- Kidney-anlage, changes in, i, 82
- Kidney blastema, development of, i, 103
- Kidney capsule, tuberculous infection of, ii, 27
- Kidney colic. See Colic, renal
- Kidney niches, muscles forming, i, 45
 position of kidney in, i, 45
 relation of, to movable kidney, i, 474
 shape of, i, 51
- Kidneys, abdominal organs in relation to, i, 62
 adrenal bodies in relation to, i, 71
 albuminuria associated with injury of, i, 207
 avenue for infection of, i, 233
 avenue for tubercular infection of, ii, 20
 changes in position of, during development, i, 83
 crest of ilium, in relation to, i, 38
 diaphragm in relation to, i, 30, 38
 difference in position of, on two sides, i, 34
 excretion of bacteria through, in health, i, 234
 functional insufficiency of. See Renal insufficiency
 functional tests for capacity. See Functional tests for renal insufficiency
 functional value of diseased, compared with normal, i, 337
 functions of, estimated separately, i, 334
 fusion of, i, 93
 large intestine in relation to, i, 39
- Kidneys, liver in relation to, i, 39
 methods for determining functional capacity of, i, 300
 normal position of, i, 15
 pleura in relation to, i, 39
 position of, in adult and in newborn, i, 92
 in relation to operation on, i, 1
 pus. See Pus kidneys; also Pyuria
 rate of secretion in, i, 273
 relation of, to diaphragm, i, 30, 38
 relative functional value of normal, i, 336
 ribs in relation to position of, i, 29, 36
 secretion of. See Renal secretion
 sensibility of, i, 242
 similarity of form in both, i, 136
 spleen in relation to, i, 39
 supernumerary, ii, 311
 topography of, from without, i, 34
 variations in position of, with sex and age, i, 35
 vascularization of. See Renal vascularization
 vertebræ and ribs in relation to, i, 34
- Knee-chest posture, in finding ureteral orifices, i, 266
 for inspection of bladder, i, 248
- Kollmann cystoscope, i, 285, 289, 292, 294
- König's incision, i, 383
- Küster's incision, for exposure of kidney, i, 380
- Labor, as cause of movable kidney, i, 470
 injury to ureter in, ii, 303
 vesico-vaginal fistula due to, ii, 407
- Lace-liver, i, 67
- Lacing, tight, as cause of movable kidney, i, 472
- Lactation, hematuria associated with, ii, 4
- Landmarks in lumbar region, i, 2
- Lenses in Nitze cystoscope, i, 287
- Lewin and Goldschmidt's experiments on peristalsis of ureter, i, 195
- Ligamentum lumbocostale, relation of, to pleura, i, 32
 to lumbar region, i, 15
- Lightning pains, with movable kidney, i, 494

- Lipomata**, of renal parenchymata, ii, 236
 of renal pelvis, ii, 237
Litholapaxy, ii, 174
 contra-indications to, ii, 177
Lithotomy position, in operation for vesico-vaginal fistula, ii, 413
Lithotripsy, ii, 173
 contra-indications to, ii, 177
Lithotrite, Bigelow's, ii, 174, 176
 combined with cystoscope, i, 290
 Young's, 176
Liver, disturbance of, associated with movable kidney, i, 490
 relation of kidneys to, i, 39
 relation of, to right kidney, i, 42, 67
Lobulated fetal kidney, ii, 312
Loeffler method, in examination of urine for tubercle bacillus, ii, 64
Loop of Henle, i, 157
Ludwig's experiments on relation between blood pressure and renal excretion, i, 183
Ludwig's theory of renal secretion, i, 176
Lumbar fascia. See *Fascia lumbodorsalis*
Lumbar incision, indications for, i, 384
 in nephrectomy for renal tuberculosis, ii, 76
Lumbar puncture, i, 3, 6
Lumbar region, arteries of, i, 16
 blood-vessels of, i, 16
 diaphragm in relation to, i, 30
 landmarks in, i, 2
 muscles and fascia of, i, 3
 nerves of, i, 21
 pleura in relation to, i, 31
 surgical relation of muscles in, i, 9
 topographical anatomy of, i, 2
 topography of, in relation to incision for exposure of kidney, i, 384
 variations in course and distribution of nerve supply to, i, 26
 veins of, i, 21
 vertebral column and ribs in relation to, i, 28
Lump kidney, ii, 321
Luy's cystoscope, i, 278, 280
Lymphatics, of adrenal bodies, i, 72
 of bladder, ii, 369
 of kidney, i, 164, 180
 of ureter, i, 171
 of urethra, ii, 371
Mackenrodt's operation for uretero-vaginal fistula, ii, 439
Malakoplakia, ii, 485
Maldevelopment, of kidney, ii, 307
 absence of kidney on one side, ii, 307
 classification of, ii, 307
 congenital atrophy, ii, 310
 embryological notes on, ii, 326
 as to form, ii, 312
 horseshoe kidney, ii, 313
 insufficient development on one side, ii, 310
 lobulated fetal kidney, ii, 312
 lump kidney, ii, 321
 as to number, ii, 307
 as to position, ii, 321
 scutiform kidney, ii, 320
 supernumerary kidneys, ii, 311
 unilateral elongated kidney, ii, 319
 of renal pelvis, ii, 326
 in lesser degree, ii, 331
 of ureter, abnormal orifices, ii, 336
 doubling of, ii, 327
 embryological notes on, ii, 326
 as to form, ii, 331
 of lesser degree, ii, 331
 as to position, ii, 331
Malformation, of renal pelvis, as to form, ii, 331
 in lesser degree, ii, 331
 as to position, ii, 331
 of urethra, ii, 564
 absence of urethra, ii, 564
 classification of, ii, 564
 double urethra, ii, 564
 epispadias, ii, 568
 hypospadias, ii, 565
 vaginal urethra, ii, 565
Malpighian body, structure of, i, 178
Malpighian corpuscle. See *Glomerulus*
Manipulative measures, in treatment of hydronephrosis, i, 546
M'Ardle's incision, i, 382
Massage, in treatment of movable kidney, i, 503
Massive degeneration of Tuffier. See *Tuffier's massive degeneration*

- Maury's operation for exstrophy of bladder, ii, 391
- Maydl's operation for exstrophy of bladder, ii, 399
- McBurney's incision, i, 382
- Medullary substance, of kidney, blood vessels of, i, 162
structure of, i, 152
- Menstruation, symptoms of movable kidney influenced by, i, 480, 485, 493
- Mercury bichlorid, injection of, in echinococcus disease of bladder, ii, 192
irrigation with, in pyelitis, ii, 210
- Mesonephros, i, 75
- Metanephros, i, 75
- Methylene-blue test, in hydronephrosis, i, 542
for renal insufficiency, i, 314
- Meyer's experiments, on diabetes insipidus, i, 187
- Microscope, appearance of pus cells under, i, 215
examination of urine under, i, 201
- Micturition. See Urination
- Mobility of kidney, degrees of, i, 495
normal, i, 461
- Morris' incision, i, 382
- Mortality, from actinomycosis, ii, 201
following Bergenhem's operation for exstrophy of bladder, ii, 403
from embryonic renal tumor, ii, 264
from exstrophy of the bladder, ii, 389
from injuries to ureter without operative treatment, ii, 306
following Maydl operation for exstrophy of bladder, ii, 400
following nephrectomy, for malignant disease of kidney, ii, 286
for polycystic kidney, ii, 181
for pyonephrosis, ii, 231
for renal cyst, ii, 275
following operation, for renal tuberculosis, ii, 74
for renal and ureteral stones, ii, 164
for ruptured kidney, ii, 301
from rupture of bladder, ii, 489, 492
following suspension of kidney, i, 515
- Movable kidney. See Kidney, movable
- Müllerian duct, development of, i, 75
- M. latissimus dorsi*, surgical relations of, i, 9
- M. obliquus externus*, arterial supply of, i, 19
surgical relations of, i, 11
- M. obliquus internus*, arterial supply of, i, 19
surgical relations of, i, 11
- M. psoas major*, surgical relations of, i, 15
- M. quadratus lumborum*, surgical relations of, i, 13
- M. sacrospinalis*, surgical relations of, i, 9
- M. serratus posticus*, inferior surgical relations of, i, 12
- M. transversalis abdominis*, arterial supply of, i, 19
surgical relations of, i, 12
- Muscles, surgical relation of, in lumbar region, i, 9
- Muscles and fascia of lumbar region, i, 3
- Myoma, of bladder, ii, 524
of urethra, ii, 591
- Myrmalid as liberator of formalin, ii, 310
- Myxoma of bladder, ii, 520
in children, ii, 526
- Negroes, immunity of, to renal calculus, ii, 99
- Nephralgia, ii, 1
decapsulation for relief of, ii, 3, 8
diagnosis of, ii, 6
etiology of, ii, 2
expectant treatment for, ii, 6
history of, ii, 1
nephritis as cause of, ii, 2
operation for, ii, 7
pathology of, ii, 28
pregnancy associated with, ii, 4
symptomatology of, ii, 5
treatment of, ii, 6
- Nephrectomy, for actinomycosis, ii, 201
after-treatment for, i, 417
causes of death after, for tuberculosis, ii, 75
closure of wound in, i, 415
for cystic kidney, ii, 275
drainage after, i, 416
for echinococcus disease, ii, 192
functional tests as guide to performance of, i, 338

Nephrectomy, for hemorrhage due to ruptured kidney, i, 225
 for hydronephrosis, i, 548
 for injury to kidney, ii, 303
 for injury to ureter, ii, 306
 intracapsular enucleation of kidney in, i, 414
 mortality after, for malignant tumor, ii, 286
 for polycystic kidney, ii, 181
 for movable kidney, i, 504
 for multiple abscesses of kidney, ii, 225
 objections to, in essential hematuria and nephralgia, ii, 8
 for polycystic kidney, ii, 281
 phloridzin test as guide to performance of, i, 313
 in pyelitis, ii, 211
 in pregnancy, ii, 215
 for pyonephrosis, ii, 226, 231
 removal of kidney in capsule, i, 413
 for renal calculus, ii, 152
 technique of, i, 412
 for renal tuberculosis, ii, 76
 for ureteral fistula, ii, 437
 Nephritis, acute, pathology of, ii, 288
 renal hemorrhage due to, i, 224
 due to syphilis, ii, 187
 acute septic, changes in kidney in, ii, 218
 chronic, classification of, ii, 289
 essential hematuria and nephralgia associated with, ii, 2
 chronic interstitial, indigo-carmin test in, i, 319
 methylene-blue test in, i, 315
 pathology and symptoms of, ii, 289
 phenolsulphonephthalein test for, i, 322
 reduced excretion of chlorids in, 309
 relation between, and re-absorptive capacity of tubules, i, 187
 renal calculus associated with, ii, 105
 renal tuberculosis associated with, ii, 33
 rosanilin test for, i, 315
 symptoms of renal insufficiency due to, i, 302
 due to syphilis, ii, 187
 chronic parenchymatous, indigo-carmin test for, i, 319
 methylene-blue test in, i, 315

Nephritis, chronic parenchymatous, pathology and symptoms of, ii, 289
 phenolsulphonephthalein test for, i, 322
 reduced excretion of chlorids in, i, 309
 symptoms of renal insufficiency due to, i, 301
 due to syphilis, ii, 187
 gummatous, ii, 187
 hemorrhagic, following collargol injection, i, 351
 parenchymatous, following injection of tuberculin, ii, 33
 Nephrocapsulectomy for Bright's disease, ii, 293
 Nephrolithiasis. See Calculus, renal
 Nephrolithotomy, i, 443
 cause of hemorrhage in, i, 443
 closure of wound after, ii, 149
 followed by nephrectomy for renal calculus, ii, 153
 for renal calculus, ii, 145
 technique of incision in, i, 445
 Nephroma embryonale malignum, ii, 262
 Nephroptosis. See Kidney, movable
 Nephrotomy, arrangement of arteries in reference to, i, 419
 for chronic pyelitis, ii, 211
 for essential hematuria and nephralgia, ii, 8
 first performance in, ii, 91
 for large pus kidneys, i, 412
 landmarks on surface of kidney in relation to, i, 437
 lobulation of kidney as guide in, i, 438
 objections to, in hydronephrosis, i, 549
 for pyelitis in pregnancy and puerperium, ii, 215
 for pyonephrosis, ii, 229
 for renal tuberculosis, ii, 83
 silver wire method of, i, 448
 surgical anatomy of kidney with reference to, i, 418
 suturing of kidney in, i, 453
 transverse incisions in, i, 457
 unusual arrangement of arteries in reference to, i, 427
 Nephro-ureterectomy, i, 407
 incisions for, i, 407

- Nerve, first lumbar, distribution of, in lumbar region, i, 24
 importance of, in fixation of kidney, i, 390
 ilio-hypogastric, distribution of, i, 25
 inguinal, distribution of, i, 26
 last thoracic, distribution of, in lumbar region, i, 24
- Nerves of adrenal bodies, i, 72
 of bladder, i, 197; ii, 369
 "border," i, 28
 of diaphragm, i, 30
 in exposure of kidney through superior lumbar trigonum, i, 389
 of kidney, i, 165, 180
 of importance in renal operations, i, 21
 of lumbar region, i, 21
 of ureter, i, 171
 of urethra, ii, 371
 variations of, in lumbar region, i, 26
- Nervous diseases, hematuria due to, i, 220
- Nervous system, action of, on renal secretion, i, 190
 disturbance of, associated with movable kidney, i, 489
 influence of, on bladder, i, 199
- Neuralgia, associated with movable kidney, i, 493
 idiopathic renal. See Nephralgia
- Neuroses of the bladder, ii, 553
 classification of, ii, 553
 diagnosis of, ii, 554
 enuresis, ii, 560
 frequency of urination, ii, 555
 incontinence of urine, ii, 557
 pain, ii, 554
 pathology of, ii, 553
 retention of urine, ii, 562
 sensory disturbances, ii, 554
 treatment of sensory disturbances, ii, 556
- Nitrogen bodies, excretion of, in renal insufficiency, i, 307, 308
- Nitrous oxid gas, in renal operations, i, 379
- Nitze cystoscope. See Water cystoscope
- Nuclei, in renal and ureteral calculi, ii, 94, 99
 reduced excretion of, in renal insufficiency, i, 308
- Nucleo-albumin, tests for, in urine, i, 208
- Onkometer, i, 177
- Operation, for entero-vesical fistula, ii, 405
 for epispadias, ii, 568
 for inaccessible vesical fistula, ii, 428
 for minute vesical fistula, ii, 427
 for multiple vesical fistulæ, ii, 427
 for rectovaginal fistula, ii, 434
 for rectovesical fistula, ii, 407
 for uretero-vaginal fistula, ii, 439
 for urethral fistula, ii, 441
 for very large vesical fistula, ii, 424
 for vesical fistula, adherent to pubic rami, ii, 431
 close to perineum, ii, 433
 with rupture of symphysis, ii, 433
 with torn perineum, ii, 434
 with ureters in margin of fistula, ii, 433
 for vesico-cervico-vaginal fistula, ii, 418
 for vesico-urethro-vaginal fistula, ii, 421
 for vesico-uterine fistula, ii, 421
 for vesico-vaginal fistula, ii, 414
- Operations, on bladder, for carcinoma, ii, 550
 for exstrophy, ii, 390
 for gunshot wounds, ii, 495
 litholapaxy, ii, 173
 lithotripsy, ii, 173
 perineal section, ii, 177
 for removal of tumors, ii, 537
 for rupture, ii, 493
 suprapubic section in, ii, 180
 vaginal, ii, 179
 for vesical calculus, ii, 170
 for vesical diverticulum, ii, 379
 for vesical tuberculosis, ii, 87
 for wounds with sharp instrument, ii, 494
- on kidney, i, 375
 for abnormal mobility, i, 504
 for acute pyelonephritis, ii, 223
 after-treatment of, i, 417
 anesthetic in, i, 378
 anuria as indication for, ii, 164
 approach through superior lumbar trigonum, i, 386
 arteries of kidney, importance of, in, i, 16
 for Bright's disease, ii, 292
 for chronic pyelonephritis, ii, 226
 classification of, i, 375, 411

- Operations on kidney, closure of wound, i, 415
 for cystic kidney, ii, 275
 delivery of kidney in, i, 410
 drainage after, i, 416
 dressing for, i, 416
 for echinococcus disease, ii, 191
 for essential hematuria and nephralgia, ii, 7
 freeing body of kidney in, i, 408
 functional tests as guide to, i, 338
 general considerations concerning, i, 375
 for hydronephrosis, conservative, i, 550
 radical, i, 548
 incisions for exposure of kidney in, i, 379
 incisions employed in extensive, i, 398
 incisions in minor, i, 386
 for injuries, ii, 300
 intracapsular enucleation, i, 414
 landmarks on surface of kidney in, i, 437
 muscles of importance in, i, 9
 nephrectomy, i, 412
 for actinomycosis, ii, 201
 for echinococcus disease, ii, 192
 for malignant tumor, ii, 284
 for pyelitis, ii, 211
 in pregnancy, ii, 215
 nephrolithotomy, i, 443
 for large pus kidneys, i, 412
 for pyelitis in pregnancy, ii, 215
 for pyonephrosis, ii, 229
 in pregnancy and puerperium, ii, 215
 nephro-ureterectomy, i, 407
 nerves of importance in, i, 21
 opening fatty capsule in, i, 408
 peculiarities of, i, 375
 for perirenal abscess, ii, 235
 for perirenal tumor, ii, 271
 for polycystic kidney, ii, 281
 position of operator in, i, 378
 position of patient in, i, 378
 preliminaries to, i, 376
 preparation of patient for, i, 376
 for pyelitis, ii, 211
 for pyonephrosis, ii, 226, 229, 231
- Operations on kidney, removal of kidney in, i, 413
 removal of kidney from capsule in, i, 414
 for renal calculus, ii, 138
 for renal tuberculosis, conservative, ii, 83
 radical, ii, 73, 76
 resection of ribs in, i, 398, 405
 types of, i, 411
 veins of importance in, i, 21
 X-ray as guide to, i, 358
 on ureter, for abnormal openings, ii, 340, 342, 343, 344, 345, 347
 for calculus, ii, 138, 154
 for injury, ii, 306
 for stricture, ii, 354, 356, 360
 for ureteral fistula, ii, 437
 on urethra, for carcinoma, ii, 596
 for incontinence of urine in middle-aged women, ii, 558
 for prolapse, ii, 575, 576, 578
 for sarcoma, ii, 599
- Operator, position of, in renal operations, i, 378
- Organisms, in cystitis, ii, 445, 456
 causing infection of urinary passages, i, 231, 232, 233, 234
 in healthy urethra, i, 229
 in pneumaturia, i, 227
 in pyelitis, ii, 204
 in pyuria, i, 214
 in renal infections, ii, 217
 secondary, in renal tuberculosis, ii, 66
 treatment of cystitis based on, ii, 458
- Oudin spark, in treatment of external urethritis, ii, 582
- Ovary, adherent, as cause of hydronephrosis, i, 528
- Pain, in cystitis, ii, 449
 in diseases of prevesical space, ii, 503
 fixed, with renal calculus, ii, 109
 following retention of catheter in ureter, i, 335
 measures for relief of, in renal and ureteral calculus, ii, 138
 in movable kidney, i, 485
 in perirenal abscess, ii, 233

- Pain, due to pressure of horseshoe kidney
 on nerve roots, ii, 336
 renal, in essential hematuria. See Nephralgia
 in tuberculosis of kidney, ii, 57
 in urological diagnosis, i, 371
 in hydronephrosis, i, 536
 in sensory disturbances of bladder, ii, 554
 as symptom, of echinococcus disease of kidney, ii, 190
 of malignant tumor of kidney, ii, 182
 of pyelitis, ii, 205
 of pyonephrosis, ii, 220
 transferred, in renal calculus, ii, 109
 ureteral, in essential hematuria, ii, 6
 urethral, significance of, in urological diagnosis of, i, 374
 with vesical diverticulum, ii, 375
 vesical, in urological diagnosis, i, 373
 in renal tuberculosis, ii, 58
- Palpation, of abdominal portion of urinary tract, i, 241
 in cystitis, ii, 450
 dorsal method of, for movable kidney, i, 496
 in erect posture for movable kidney, i, 498
 in examination of urinary tract, i, 237
 Israel's method of, for movable kidney, i, 497
 of kidney in renal tuberculosis, ii, 61
 of kidneys, i, 242
 for movable kidney, i, 496
 of pelvic portion of urinary tract, i, 237
 in perirenal abscess, ii, 233
 in pyonephrosis, ii, 222
 for renal and ureteral calculus, ii, 116
 of renal portion of urinary tract, i, 242
 of ureters, i, 240
 of urethra, i, 237
 of vesical tract, i, 240
- Pancreas, attachment of kidney to, i, 465
 relation of left kidney to, i, 69
- Panoptic cystoscope, i, 290
- Papillæ, renal number of, i, 143
- Papillary cystoma, malignant, as sequel to rupture of kidney, ii, 297
- Papilloma, of bladder, ii, 509
 in child, ii, 526
- Papilloma, of renal pelvis, ii, 237
 of renal pelvis and ureter, ii, 255
- Paraffin injection, for incontinence of urine, ii, 559
- Pararenal fat, i, 50
 color of, i, 390, 403, 408
 distribution of, i, 390
 position of, i, 52
 as protection to kidney, i, 39, 51
- Parasites, hematuria due to, i, 223
- Parenchyma, renal. See Renal parenchyma
- Patient, general examination of, for renal calculus, ii, 114
 position of. See Position of patient
 preparation of, for operation in Bright's disease, ii, 293
 for operations on kidney, i, 376
 for use of X-ray, i, 347
- Pean's incision, i, 381
- Pelves, renal, number of, in one kidney, i, 142
 double, ii, 126
 single, i, 418
- Pelvic organs, disturbance of, associated with movable kidney, i, 492
- Pelvis, renal, anastomosis between, and bladder for relief of hydronephrosis, i, 553
 arrangement of arteries in divided, i, 427
 benign tumors of. See Tumors of renal pelvis, benign
 blood-vessels of, i, 164
 capacity of, in human being, i, 520, 542, 554
 development of, i, 117
 direction of, i, 149
 divided, i, 147, 419
 effect of rotation of kidney on axis of, i, 132
 embryological notes on maldevelopment of, ii, 326
 forms of, characteristic of animals, i, 139
 characteristic of man, i, 142
 from surgical standpoint, i, 418
 in horseshoe kidney, ii, 313
 inflammation of, ii, 216
 with leaf-like attachment, i, 141
 location of, i, 144
 macroscopic structure of, i, 154
 malformation of, in lesser degree, ii, 331

- Pelvis, method of opening, for renal calculus, ii, 142
microscopic structure of, i, 159
physiology of, i, 194
plication of, for relief of hydronephrosis, i, 552
primitive, i, 139
shape of, i, 146
in relation to extraction of calculus, ii, 142
simple, i, 139
single, i, 146
size of, i, 144
surface of kidney in relation to, i, 119
with tubular prolongations, i, 141
tumors of. See Tumors of renal pelvis
- Percussion, in examination of urinary tract, 236
for movable kidney, i, 498
in perirenal abscess, ii, 233
in pyonephrosis, ii, 222
for renal calculus, ii, 117
- Perineal section, for vesical calculus, ii, 177
- Perinephric abscess, as sequel to rupture of kidney, ii, 297
- Perirenal abscess. See Abscess, perirenal
- Perirenal fascia. See Fascia perirenalis
- Perirenal fat, i, 50
blood-vessels of, i, 54
color of, i, 403, 408
distribution of, i, 391
function of, i, 464
as protection to kidney, i, 39
relations of, i, 53
- Perirenal infection, secondary to renal tuberculosis, ii, 43
- Perirenal inflammations, ii, 231
definition of, ii, 216
diagnosis of, ii, 234
etiology of, ii, 231
pathological anatomy of, ii, 232
prognosis of, ii, 234
symptoms of, ii, 233
treatment of, ii, 235
- Perirenal tumors, ii, 270
classification of, ii, 270
diagnosis of, ii, 271
prognosis of, ii, 271
symptoms of, ii, 271
treatment of, ii, 271
- Peritonitis, due to rupture of kidney, ii, 299
- Periurethritis chronica, ii, 587
- Peters' operation for exstrophy of bladder, ii, 400
- Petit's triangle, position and relations of, i, 3, 5
- Phenolsulphonephthalein test, experimental results from, i, 321
personal observations on, i, 323
for renal insufficiency, i, 321
tables showing output in, i, 324
technique of, i, 321
- Phleboliths, distinction between, and ureteral calculus, i, 363
X-ray in diagnosis of, i, 363
- Phloridzin, action of, on renal epithelium, i, 187
- Phloridzin test, i, 312
- Phloroglucin, as liberator of formalin, ii, 210
- Phosphates, excretion of, as test for renal insufficiency, i, 309
in urine. See Phosphaturia
- Phosphaturia, i, 209
- Pleura, relation of kidneys to, i, 39
relation of lumbo-costal ligaments to, i, 32
- Plica ureterica, ii, 364
- Pneumaturia, i, 225
cause of gas formation in, i, 227
gas formation in neighboring organs, i, 225
organisms present in, i, 227
source of gas in, i, 225
spontaneous formation of gas in, i, 226
treatment of, i, 228
varieties of gases in, i, 228
- Polariscopic test, i, 210
- Pollakiuria. See Urination, frequent
- Polycystic kidney, ii, 275
course of, ii, 278
diagnosis of, ii, 280
etiology of, ii, 277
occurrence of, ii, 275
pathology of, ii, 275
stages of, ii, 278
symptoms of, ii, 278
theories as to cause of, ii, 277
treatment of, ii, 281

- Polypi, mucous, of urethra, ii, 591
 Polyuria, associated with pyuria, i, 218
 increase of solids in urine with, i, 186
 in renal tuberculosis, ii, 59
 character of urine during, i, 185
 drugs as cause of, i, 186
 Poncet's incision, i, 380
 Position of patient, in cystoscopic examination, i, 277; ii, 452
 in drainage of bladder by vesical incision for cystitis, ii, 467
 in examination of urinary tract, i, 244, 248
 for examination by water cystoscope, i, 296
 in excision of diseased area for cystitis, ii, 471
 in finding ureteral orifice, i, 266
 for inspection of bladder, i, 248
 in nephrectomy for renal tuberculosis, ii, 76
 after operation on kidney, i, 417
 in operation for rupture of bladder, ii, 493
 in operation for vesico-vaginal fistula, ii, 413
 in operations on kidney, i, 378
 in palpation of movable kidney, i, 496, 497, 498
 in renal operations, i, 378
 in suspension of kidney, i, 508
 in topical treatment of cystitis, ii, 465
 for use of wax-tipped catheter, ii, 127
 in X-ray examination, i, 348
 Posner's method of estimating pus in urine, i, 215
 Post-mortem specimens, evidence of, on tuberculous infection of kidney through ureter, ii, 29
 Post-operative complications in suspension of kidney, i, 515
 Post-operative treatment for suspension of kidney, i, 517
 Postural albuminuria, i, 206
 Posture, influence of, on hydronephrosis, ii, 168
 on vesical calculus, ii, 168
 Pousson's operation for vesical diverticulum, ii, 383
 Pregnancy, as cause of exfoliative cystitis, ii, 481
 as cause of movable kidney, i, 470
 hematuria and nephralgia associated with, ii, 4
 pyelitis in, ii, 213
 rupture of bladder in, ii, 488
 Premature development, adrenal tumors associated with, ii, 269
 Prevesical space, anatomical relations of, 497
 diseases of, ii, 497
 anatomical relations in regard to, 497
 classification of, ii, 498
 clinical history of, ii, 499
 definition of, ii, 497, 502
 differential diagnosis of, ii, 503
 etiology of, ii, 502
 history of, ii, 498
 inflammatory tumors, ii, 499
 introductory to, ii, 497
 literature on, ii, 505
 symptoms of, ii, 500
 treatment of, ii, 504
 Prism, in Nitze cystoscope, i, 288
 Prolapse of urethra, ii, 574
 in adults, ii, 574
 diagnosis of, in girls, ii, 578
 etiology of, in adults, ii, 574
 in girls, ii, 577
 in girls, ii, 577
 pathology of, in adults, ii, 576
 treatment of, in adults, ii, 576
 in girls, ii, 578
 thrombosis of veins in, ii, 575
 Pronephros, i, 75
 Prostate gland, hematuria due to enlargement of, i, 220, 224
 involvement of, in renal tuberculosis in boys, ii, 24
 Proteid bodies, found in the urine, i, 206
 tests for, in urine, i, 208
 Psychic treatment for incontinence of urine, ii, 560
 Puerperium, pyelitis in, ii, 213
 Puncture in hydronephrosis, i, 547
 Pus, methods for estimating, in urine, i, 215
 relation between, and albumin in pyuria, i, 217

- Pus, in urine. See Pyuria
- Pus cells, microscopic appearance of, in urine, i, 215
- Pus kidneys. See Pyuria
- Pyelitis, ii, 203
- bacteria causing, i, 234
 - in children, ii, 212
 - diagnosis of, ii, 213
 - etiology of, ii, 212
 - occurrence of, ii, 212
 - symptoms of, ii, 212
 - treatment of, ii, 213
- contributory causes in, ii, 204
- definition of, ii, 203
- diagnosis of, ii, 206
- etiology of, ii, 203
- in general, ii, 203
- lavage of kidney for, ii, 210
- nephrectomy for, ii, 211
- operation for, ii, 211
- organisms present in, ii, 204
- pathology of, ii, 204
- portals of entry in, ii, 203
- in pregnancy and puerperium, ii, 213
- diagnosis of, ii, 214
 - etiology of, ii, 214
 - symptoms of, ii, 214
 - treatment of, ii, 215
- prognosis in, ii, 207
- symptoms of, ii, 205
- treatment of, ii, 207
- urinary antiseptics in, ii, 207
- vaccine therapy for, ii, 210
- Pyelograph, in diagnosis of polycystic kidney, ii, 281
- Pyelography, in diagnosis of malignant renal tumor, ii, 284
- Pyelonephritis, ii, 216
- complicating vesical fistula, ii, 435
 - definition of, ii, 216
 - diagnosis of, ii, 220
 - operation for acute, ii, 223
 - pathological anatomy of, ii, 217
 - symptoms of acute, ii, 219
 - treatment of, acute, ii, 223
 - chronic, ii, 226
- Pyelotomy, field for, i, 441
- for renal calculus, ii, 139
- Pyonephrosis, ii, 216
- conservative treatment for, ii, 226, 227
- Pyonephrosis, definition of, ii, 216, 219
- diagnosis of, ii, 221
 - etiology of, ii, 216
 - mortality after nephrectomy for, ii, 231
 - pathological anatomy of, ii, 217
 - radical treatment of, ii, 231
 - due to renal calculus, ii, 106
 - secondary to renal tuberculosis, ii, 45
 - as sequel to rupture of kidney, ii, 297
 - symptoms of, ii, 219
 - treatment of, ii, 226
 - due to vesical diverticulum, ii, 375
 - X-ray in diagnosis of, i, 360
- Pyuria, i, 213
- albumin in, i, 216
 - appearance of urine in, i, 214
 - chemical test for, i, 215
 - definition of, i, 213
 - examination of urine in, i, 218
 - general considerations in regard to, i, 217
 - intermittent, ii, 220
 - methods for estimating pus in, i, 215
 - microscopic appearance of pus cells in, i, 215
 - organisms present in, i, 214, 216
 - reaction of urine in, i, 214
 - relation between pus and albumin in, i, 217
 - with renal calculus, ii, 116
 - in renal tuberculosis, ii, 65
 - significance of, in cystitis, ii, 450
 - sources of pus in, i, 213
- Race, influence of, on renal calculus, ii, 99
- Radiography. See X-ray
- Radium, for carcinoma of urethra, ii, 597
- for sarcoma of urethra, ii, 599
 - in stricture of urethra, ii, 587
 - in treatment of sensory disturbances of bladder, ii, 555
 - vesical tumor treated by, ii, 536
 - for vesical tumors in children, ii, 529
- Rasch's operation for epispadias, ii, 572
- Rayer's atlas, ii, 20
- Rayer's classification of tuberculous kidneys, ii, 19
- Rectum, opening of ureter into, ii, 348
- prolapse of, with exstrophy of bladder, ii, 386

- Red blood cells in urine in renal tuberculosis, ii, 66
- Ren arcuatus. See Horseshoe kidney
- Ren elongatus. See Kidney, elongated
- Ren elongatus simplex. See Kidney, simple elongated
- Ren informis. See Lump kidney
- Ren scutaneus. See Scutiform kidney
- Ren sigmoideus. See Sigmoid kidney
- Renal calculus. See Calculus, renal
- Renal colic, in essential hematuria, ii, 1
- in hydronephrosis, i, 536
- irritability of bladder with, ii, 111
- in movable kidney, i, 486
- with renal calculus, ii, 107
- reproduction of, as diagnostic sign, i, 371, 485
- spontaneous passage of stones during, ii, 110
- in tuberculosis of kidney, ii, 57
- Renal cysts. See Cysts of kidney
- Renal epistaxis. See Hematuria, essential
- Renal hemorrhage. See Hemorrhage, renal
- Renal infections, diagnosis of, ii, 220
- elimination of, in treatment of cystitis, ii, 459
- etiology of, ii, 216
- organisms present in, ii, 217
- pathological anatomy of, ii, 217
- symptoms of, ii, 219
- treatment of, ii, 223
- Renal insufficiency, i, 301
- amount of urine in, i, 307
- chemical findings of urine in, i, 308
- combination of tests for, i, 335
- comparison of two sides as to, i, 304
- constituents of urine in, i, 308
- cryoscopy, of blood as test for, i, 305
- of urine as test for, i, 310
- disagreeable sequelæ of functional tests for, i, 334
- in diseased kidney, compared with healthy organ, i, 337
- freezing point of blood as test for, i, 305
- ideals of tests for, i, 301
- indigo-carmin test for, i, 315
- methods of determining, dependent on examination of blood, i, 304
- dependent on examination of urine, i, 307
- Renal insufficiency, methylene-blue test for, i, 314
- nitrogen bodies excreted in, i, 307
- operations on kidney in relation to, i, 338
- phenolsulphonephthalein test for, i, 321
- phloridzin test for, i, 312
- phosphates excreted in, i, 309
- physical characteristics of urine in, i, 307
- with polycystic kidney, ii, 279
- possibilities of functional tests for, i, 303
- due to renal calculus, ii, 115
- rosanilin test for, i, 315
- significance of, in urinary disorders, i, 370
- sodium chlorid deficiency in, i, 309
- stages of, i, 302
- tests for, dependent on examination of blood, i, 304
- dependent on examination of urine, i, 307
- dependent on excretion of foreign substances, i, 312
- types of, i, 301
- urethral catheterization as test of, i, 333
- value of comparative estimations, i, 338
- Renal operations. See Operations on kidney
- Renal palpation. See Kidney, palpation of
- Renal parenchyma, inflammation of, ii, 216
- tumors of. See Tumors of renal parenchyma
- Renal pelvis. See Pelvis, renal
- Renal secretion, action of nervous system upon, i, 190
- chemical and physical characteristics of, i, 191
- experiments on, i, 181
- general conclusions on, i, 193
- general considerations concerning, i, 175
- gross anatomy of kidney in relation to, i, 177
- influence of blood pressure upon, i, 183
- normal amount of, i, 191
- normal rate of, i, 273
- relation between amount of, and amount of blood flowing through kidney, i, 183
- relation of, to constitution of blood, i, 183
- theories regarding, i, 176

Renal vascularization, i, 93
in abnormally placed kidneys, ii, 325
development of, i, 93
effect of rotation of kidney upon, i, 133
hemorrhage during renal operations in
relation to, i, 443
method of detecting variations in, i, 444
Renal tuberculosis. See Tuberculosis of
kidney
Renipuncture, essential hematuria relieved
by, ii, 38
Resection of kidney, i, 430
in echinococcus disease, ii, 191
possibility of, in tuberculosis, ii, 40
for renal tuberculosis, ii, 83
surgical anatomy of kidney with refer-
ence to, i, 408
Resection of ribs, in operations on kidney,
i, 12, 398, 405
Resection of urethra, for stricture, ii,
586
Rest in bed, in essential hematuria, ii, 7
before operations on kidney, i, 377
in pyelitis, ii, 207
in treatment of movable kidney, i, 503
Retention of urine, ii, 562
diagnosis of, ii, 563
as symptom of urinary disease, i, 373
treatment of, ii, 563
Retention cysts of kidney, ii, 272
Retroperitoneal fat. See Pararenal fat
Retroperitoneal incision, indications for, i,
384
Retzius, space of. See Prevesical space
Rhabdo-myosarcomatosum, in child, ii, 527
Ribs, fracture of, with rupture of kidney,
ii, 296
relation of, to kidneys, i, 29, 36
resection of. See Resection of ribs
Robert's fermentation test, i, 210
Robson's incision, i, 382
Rosanilin test for renal insufficiency, i, 315
Rotation of kidney, effect of, on axis of
renal pelvis and direction of
calices, i, 132
on contour and form of kidney, i, 133
on distribution of renal blood-vessels,
i, 133
on form of kidney, i, 130
on location of hilum, i, 132

Roy-Cohnheim onkometer, i, 177
Rudimentary kidney, ii, 310
Saline infusion, after injury to bladder, ii,
495
Salivation, with movable kidney, i, 493, 494
Sarcoma, of bladder, ii, 522
in children, ii, 526
of kidney, ii, 239
of renal pelvis and ureter, ii, 262
of urethra, ii, 597
prognosis in, ii, 599
Schistosoma hematobium, ii, 193
Schlaginweit's cystoscope, i, 285, 289
Schmidt's operation, for exstrophy of blad-
der, ii, 391
Scratch-marks, in diagnosis of renal cal-
culus, ii, 129
examination of, ii, 129
Scutiform kidney, ii, 320
Searcher, in examination of bladder, i,
263
Sectio alta. See Suprapubic section
Sedatives, after renal operations, i, 417
Seminal vesicles, involvement of, in renal
tuberculosis in boys, ii, 24
Sensory disturbances of bladder, ii, 554
treatment of, ii, 556
Sequestration, cystitis treated by, ii, 474
Sero-hemorrhagic cysts of kidney, ii, 272
Serous cysts of kidney, ii, 272
diagnosis of, ii, 275
etiology of, ii, 272
pathological anatomy of, ii, 272
symptoms of, ii, 274
treatment of, ii, 275
Serum-albumin, tests for, in urine, i, 208
Sexes, comparative frequency of movable
kidney in the, i, 466
comparative frequency of vesical diver-
ticula in, ii, 372
difference in length of ureter in the, i,
168
difference in weight of kidneys in the,
i, 139
different topography of lumbar region
in, i, 3
frequency of vesical calculus in different,
ii, 165
in relation to pyelitis in children, ii, 212

- Sexes, relative frequency of renal tuberculosis in, ii, 28
 urethral calculus in, ii, 183
 variations in position of kidneys in the, i, 35
 Shield-shaped kidney. See Scutiform kidney
 Shock, due to rupture of kidney, ii, 298
 treatment of, ii, 495
 Side position, for inspection of bladder, i, 251
 Sigmoid kidney, ii, 320
 Silver, organic salts of, irrigation with, in pyelitis, ii, 210
 Silver iodid injections as aid to X-ray examination, i, 350; ii, 125
 with X-ray in renal tuberculosis, ii, 71
 Silver nitrate, as irrigation fluid in pyelitis, ii, 210
 Silver nitrate injection, after operation for vesical calculus, ii, 176
 Silver wire method of nephrotomy, i, 448
 removal of renal calculus by, ii, 146
 Simon's incision, i, 379
 Simon's method of suturing vesico-vaginal fistula, ii, 417
 Sims' posture, for inspection of bladder, i, 251
 in operation for vesico-vaginal fistula, ii, 413
 in reproduction of renal pain, i, 500
 Sinus renalis, cyst of, a cause of hydronephrosis, i, 528
 structure of, i, 150
 Skene's glands, appearance of, when inflamed, i, 239, 244
 inflammation of, ii, 581
 treatment for, ii, 582
 Skin, treatment of, preparatory to renal operations, i, 377
 Smears, in examination of urine for tubercle bacillus, ii, 64
 Sodium chlorid, excretion of, as test for renal insufficiency, i, 306, 309
 hemolytic power of, as test for renal insufficiency, i, 306
 "Solitary kidney," ii, 309
 Sonnenburg's operation, for exstrophy of bladder, ii, 394
 Sound, in diagnosis of ureteral stricture, ii, 353
 in diagnosis of vesical calculus, ii, 169
 in examination of urinary tract, i, 237
 Specific gravity test, i, 210
 Speculum, examination of bladder by, i, 253
 hair-pin, i, 244; ii, 581
 oblique, i, 267
 Sphincter muscle of bladder, i, 197
 Spleen, relation of kidneys to, i, 39
 Splenic flexure of colon, relation of left kidney to, i, 70
 Stalagmite bladder, ii, 449
 Stereoscopic pictures, i, 349
 Sterilization, of ureteral catheters, i, 267
 of water cystoscope, i, 294
 Stiles' operation, for epispadias, ii, 572
 Stomach, dilatation of, a cause of movable kidney, i, 481, 489
 due to traction by movable kidney, i, 483, 489
 relation of left kidney to, i, 67
 Stone, in the bladder. See Calculus, vesical
 in the kidney. See Calculus, renal
 in urethra. See Calculus, urethral
 Strangury associated with rupture of bladder, ii, 490
 Stricture, of ureter, ii, 349
 as cause of hydronephrosis, i, 523, 550
 classification of, ii, 352
 congenital, ii, 356
 etiology of, ii, 349
 inflammatory, ii, 352
 in renal tuberculosis, ii, 68
 traumatic, ii, 354
 of urethra, ii, 585
 treatment of, ii, 586
 Stypticin, for hematuria, i, 225; ii, 7
 Subcostal artery, relation of, to lumbar incision, i, 16
 Suburethral abscess. See Abscess, suburethral
 Sugar, excretion of, in urine as test for functional capacity of urine, i, 312
 significance of, in urine, i, 210
 tests for, in urine, i, 210
 Supernumerary kidneys, ii, 311

Supports, in treatment of movable kidney, i, 502, 503
 Suprapubic operation, for excision of diseased area in cystitis, ii, 471
 Suspension of kidney. See Kidney, suspension of
 Sutures, choice of, for suspension of kidney, i, 506, 507
 in closure of vesico-vaginal fistula, ii, 415
 in nephrotomy, i, 454
 placing of, in suspension of kidney, i, 512
 in rupture of bladder, ii, 493
 in suprapubic section into bladder, ii, 182
 Symphysis, disease of prevesical space due to injury of, ii, 499
 Syphilis, of bladder, ii, 483
 diagnosis of, ii, 484
 signs of, ii, 483
 treatment of, ii, 484
 of ureter, stricture caused by, ii, 188, 349
 of urethra, ii, 187, 583
 treatment of, ii, 584
 of urinary tract, of bladder, ii, 188
 of kidney, ii, 187
 treatment of, ii, 188

Tabes, hematuria associated with, ii, 4

Table, of age for prolapse of urethra in girls, ii, 577
 of analysis of initial symptoms of renal tuberculosis, ii, 60
 of average number of renal calices, i, 122
 of average number of renal fornices, i, 122
 of average number of renal fornices and calices, i, 122
 of comparative frequency of movable kidney in two sexes, i, 466
 of comparative size of right and left kidney in young children, i, 124
 of comparative sizes of kidney in adult and newborn, i, 122
 of difference in length of ureter in the sexes, i, 168
 of Edebohls' results from surgical treatment of Bright's disease, ii, 291
 of excretion of indigo-carmin compared with phenolsulphonephthalein, i, 331

Table, of excretion of phenolsulphonephthalein in diseased kidneys, i, 329
 by healthy kidneys, i, 324
 of length of divisions in uriniferous tubule, i, 159
 of length of kidney at different periods during first two years, i, 124
 of length of renal pyramids compared with cortex at different periods of life, i, 125
 of length of XII rib in fifty cadavers, i, 36
 of movable kidney at different ages, i, 468
 of proportion of organic and inorganic substances in urine. (Weiss), i, 192
 of relation between pyramid and cortex at different ages, i, 125
 of relation between surface of kidney and internal structure, i, 439
 of relative thickness of renal cortex and medulla, i, 152
 at different periods of life, i, 124
 of results of operation for rupture of the bladder, ii, 492
 of size of kidney in adult and newborn, i, 122
 of statistics of tuberculous kidneys at autopsy with tuberculosis elsewhere, ii, 22
 of statistics of tuberculous kidney without tuberculosis elsewhere, ii, 22
 of thickness of renal cortex and medulla, i, 124
 of transverse diameter of kidney at different stages of development, i, 116
 of variations in capacity of bladder, ii, 361
 of variations in number of minor renal calices, i, 143
 of variations in number of renal papillæ, i, 143
 Tænia echinococcus, ii, 188
 Temperature, elevation of, in acute pyelonephritis, ii, 219
 after injury to bladder and urethra, ii, 490
 in malignant tumor of kidney, ii, 282

- Temperature, elevation of, in perirenal abscess, ii, 233
 in pyelitis, ii, 205, 207
 in children, ii, 213
 during pregnancy and puerperium, ii, 214
 in pyonephrosis, ii, 220
 with renal calculus, ii, 113
 in renal tuberculosis, ii, 56
 due to rupture of kidney, ii, 299
- Tenderness, area of, due to rupture of kidney, ii, 299
- Test, for albumin, in hematuria, i, 221
 in urine, i, 205, 208
 apparatus for use in dye, i, 317
 Bouehard's, i, 307
 chemical, for pyuria, i, 215
 experimental polyuria and, i, 336
 Jolles', i, 205
 phloridzin, i, 312
 rosanilin, i, 315
 combination of functional, for renal insufficiency, i, 335
 disagreeable sequelæ to functional, i, 334
 functional, for hydronephrosis, i, 542
 for renal insufficiency. See Functional tests
 indigo-carmin, i, 315
 for liberation of formalin, ii, 207, 210
 methylene-blue, i, 314
 phenolsulphonaphthalein, i, 321
 for proteid bodies in urine, i, 208
 for renal insufficiency, dependent upon examination of blood, i, 304
 dependent upon examination of urine, i, 307
 dependent upon excretion of foreign substances, i, 312
 for serum albumin, i, 208
 for sugar in urine, i, 210
- Thiersch and Billroth's flaps, ii, 391
- Three-plate method of X-ray examination, i, 348
- Thrombosis of veins in prolapsed urethra, ii, 575
- Tillmann's incision, i, 382
- Topography of lumbar region, influence of, on incision for renal operations, i, 384
- Transvesical collection of urine in renal tuberculosis, ii, 68
- Trauma, as cause of hydronephrosis, i, 526
 as cause of movable kidney, i, 478
- Trendelenburg position, in excision of diseased area for cystitis, ii, 471
- Trendelenburg's operation for exstrophy of bladder, ii, 393
- Trigonum, superior lumbar, approach to kidney by, i, 386
 blood supply of, i, 16
 boundaries of, i, 386, 389
 exposure of, i, 388
 incision lateral to, in extensive renal operations, i, 398
 nerve supply of, i, 21
 position and relations of, i, 3, 6
 variable size of, when XII rib is wanting, i, 28
 vesical, appearance of, i, 263
 with water cystoscope, i, 298
 diagnosis between hyperemia of, and cystitis, ii, 455
- Tub treatment for cystitis, ii, 468
- Tubercle bacillus, distribution of, along renal blood vessels, ii, 51
 isolation of, ii, 20
 portal of entry for, in renal tuberculosis, ii, 26
 reaction set up by, in kidney, ii, 31
 in renal infections, ii, 217
 results following injection of chloroform extract of, ii, 38
 results following injection of ether extract of, ii, 33
 site of selection for development of, in kidney, ii, 32
 in urine in renal tuberculosis, ii, 63
- Tuberculin, in diagnosis, of perirenal inflammation, ii, 234
 of renal tuberculosis, ii, 63
 parenchymatous nephritis following injection of, ii, 33
 in tuberculosis of bladder, ii, 89
- Tuberculosis, of bladder, ii, 86
 excision of bladder for, ii, 87
 medical treatment for, ii, 88
 pathology of, ii, 86
 prognosis of, ii, 87
 treatment of, ii, 87

Tuberculosis, caseo-cavernous, frequency of
 unilateral, in kidney, ii, 24
 relative frequency of, in kidney, ii, 23
 of epididymis, ii, 29
 genito-urinary, frequency of, in men and
 women, ii, 28
 of kidney, avenue for infection in, ii, 20
 bladder symptoms associated with, ii,
 57
 catheterization of ureters in, ii, 68
 causes of death after nephrectomy for,
 ii, 75
 cavity formation in, ii, 38
 changes in urine in, ii, 59
 complications following operation for,
 ii, 85
 conservative operations on kidney for,
 ii, 83
 conservative surgery for, ii, 40
 cultural methods of diagnosis in, ii,
 67
 cystoscopy in, ii, 67
 diagnosis of, ii, 61
 with double ureters, ii, 49
 enlargement of kidney in, ii, 40
 examination of other kidney in, ii, 69
 frequency of, ii, 21
 at autopsies, ii, 22
 at autopsy with tuberculosis else-
 where, ii, 22
 caseo-cavernous form of unilateral,
 ii, 24
 miliary form of, ii, 22
 primary occurrence of, ii, 25
 functional tests in, ii, 70
 general symptoms in, ii, 56
 gross types of, ii, 38
 hematuria in, ii, 59
 history of, ii, 19
 history of operation for, ii, 20, 74
 hydronephrosis associated with, i, 528
 immunity of bladder in, ii, 59
 infection of capsule by invasion from
 contiguous organ, ii, 27
 infection through arterial blood system,
 ii, 31
 infection through ureter, ii, 27
 influence of age upon form of, ii, 23
 involvement of ureter in, ii, 49
 medical treatment of, ii, 72

Tuberculosis of kidney, methods of exam-
 ining urine for tubercle bacillus
 in, ii, 64
 mortality after operation of, ii, 74
 nephrotomy for, ii, 83
 occurrence of, ii, 21
 organisms secondary to tubercle bacil-
 lus in, ii, 66
 pain in kidney as symptom of, ii, 57
 palpability of kidney and ureter in, ii,
 61
 pathology of, ii, 31
 polyuria in, ii, 59
 portal of entry for tubercle bacillus in,
 ii, 26
 prognosis in, ii, 71
 pus in urine in, ii, 65
 red blood cells in urine in, ii, 66
 relative frequency of miliary and caseo-
 cavernous forms, ii, 23
 renal colic in, ii, 57
 renal symptoms in, ii, 56
 resection of kidney in, ii, 83
 retraction of ureter in, ii, 68
 secondary infection in, ii, 42
 spontaneous healing in, ii, 72
 stricture of ureter associated with, ii,
 68, 349
 summary of symptoms of, ii, 60
 symptomatology of, ii, 53
 technique of nephrectomy for, ii, 76
 theory of ascending infection in, ii, 20
 treatment of, ii, 73
 tuberculin in diagnosis of, ii, 63
 tumor in, ii, 56
 unilateral involvement in caseo-caver-
 nous form of, ii, 24
 ureter thickened in, ii, 62
 ureters closed in, ii, 40
 ureters open in, ii, 41
 urinary examination in, ii, 63
 vesical pain in, ii, 58
 vesical symptoms in, ii, 58
 X-ray in diagnosis of, i, 362; ii, 70
 miliary experimental production of, in
 kidney, ii, 32
 relative frequency of, ii, 23
 tuberculosis of kidney associated with,
 ii, 23
 of ureters, ii, 85

- Tuberculosis of ureters, extension of tuberculosis through, ii, 27
 involvement of, ii, 49
 pathology of, ii, 40, 41, 51
- Tubule, collecting, i, 158, 179
 convoluted, i, 178
 first convoluted, i, 156
 junctional, i, 158
 second convoluted, i, 157
 urinerous, i, 154
- Tuffier's massive degeneration, secondary to renal tuberculosis, ii, 44
- Tumor, in diseases of prevesical space, ii, 503
 in hydronephrosis, i, 537
 in malignant disease of kidney, ii, 248
 perirenal. See Perirenal tumors
 in perirenal abscess, ii, 233
 due to rupture of kidney, ii, 299
 as symptom of echinococcus disease of kidney, ii, 190
 as symptom of malignant disease of kidney, ii, 282
 of pyonephrosis, ii, 220
 due to ureteral injury, ii, 306
- Tumors, adrenal. See Adrenal tumors
- of bladder, ii, 506
 adenoma, ii, 515
 angioma, ii, 525
 carcinoma, ii, 516
 in children, ii, 526
 classification of, ii, 507
 cysts of vesical mucosa, ii, 514
 dermoid cysts, ii, 517
 diagnosis of, ii, 530
 fibroma, ii, 522
 fibromyxoma, ii, 520
 general considerations on, ii, 508
 history of, ii, 506
 myoma, ii, 524
 myxoma, ii, 520
 papilloma, ii, 509
 radium in treatment of, ii, 536
 removal of, by extraperitoneal suprapubic cystotomy, ii, 538
 by high-frequency current, ii, 534
 by snare, ii, 534
 by transperitoneal suprapubic cystotomy, ii, 546
 by vaginal extirpation, ii, 537
- Tumors of bladder, sarcoma, ii, 522
 symptoms of, ii, 529
 in children, ii, 528
 transition from benign to malignant, ii, 513
 treatment of, ii, 533
 in children, ii, 529
- of kidney, malignant, adenoma, ii, 239
 carcinoma, ii, 239
 classification of, ii, 236
 diagnosis of, ii, 249
 differential diagnosis of, ii, 282
 duration of, 248
 embryonic. See Embryonic tumors of kidney
 epithelioma, ii, 262
 frequency of, ii, 236
 different varieties, ii, 238
 hypernephroma, ii, 251
 movable kidney due to, i, 470
 occurrence of, 238
 papillary epithelioma, ii, 255
 papilloma, ii, 282
 of renal parenchyma, ii, 236
 results of operation for, ii, 284
 sarcoma of renal parenchyma, ii, 252
 of renal pelvis, ii, 262
 symptoms of, ii, 248
 treatment of, ii, 284
- of renal parenchyma, benign, ii, 236
 malignant, ii, 237
- of renal pelvis, benign, ii, 237
 malignant, ii, 255
- of ureter, ii, 236
 epithelioma, ii, 262
 papillary epithelioma, ii, 255
 sarcoma, ii, 262
- Typhoid bacillus, in renal infections, ii, 217
- Typhoid fever, disease of prevesical space caused by, ii, 502
- Ulcer of bladder, classification of, ii, 479
 as complication of cystitis, ii, 479
 diagnosis of, ii, 480
 etiology of, ii, 479
 symptoms of, ii, 479
 treatment of, ii, 480
- "Unsymmetrical kidney," ii, 309
- Urachus, patent, ii, 372

- Urea, excretion of, in renal insufficiency, i, 303
as test for renal insufficiency, i, 308
- Ureter, abnormal curves of, a cause of hydronephrosis, i, 524
abnormal division of, ii, 331
actinomycosis of. See Actinomycosis
anatomy of, i, 168
arteries of, i, 170
bifurcated, renal calculus with, ii, 126
bimanual palpation of, i, 240
blood-vessels of, i, 170
changes in, during development, i, 84
closure of, due to rupture of kidney, ii, 297
course of, i, 168
cysts of, ii, 349
dilatation of, with bougies in removal of stone, ii, 160
dimensions of, i, 168
disease of, suitable for X-ray diagnosis, i, 352, 362
double, formation of, ii, 330
theories as to formation of, ii, 327
with tubercular kidneys, ii, 51
X-ray in diagnosis of, i, 366
funnel-shaped, ii, 68
golf-hole, ii, 68
hematuria due to abnormalities of, 220
high insertion of, associated with hydronephrosis, i, 526
implantation of, into bowel or skin, ii, 88
incisions for exposure of, i, 379
independent, to horseshoe kidney, ii, 316
infection through, in renal tuberculosis, ii, 27
inspection of, i, 243
involvement of, in renal tuberculosis, ii, 49
lesions in, caused by Bilharzia hematobia, ii, 195
lymphatics of, i, 171
macroscopic structure of, i, 154, 169
maldevelopment of. See Maldevelopment of ureter
method of determining location of obstruction in, ii, 120
nerves of, i, 171
operations on. See Operations on ureter
- Ureter, pain in, associated with essential hematuria, ii, 6
palpation of, for calculus, ii, 117
in renal tuberculosis, ii, 61
peristalsis in, i, 194
physiology of, i, 194
plastic operations on, in hydronephrosis, i, 552
prolapse of. See Prolapse of urethra
ramifying, i, 139
retraction of, in renal tuberculosis, ii, 68
single, opening into vagina, ii, 342
opening into vestibule of vagina, ii, 343
stricture of. See Stricture of ureter
supernumerary, blood-vessels causing compression of, i, 525, 550, 551
opening into female urethra, ii, 339
opening into vagina, ii, 342
opening into vestibule of vagina, ii, 346
symptoms connected with, in urinary disorders, i, 372
syphilis of, ii, 188
thickening of, in renal tuberculosis, ii, 62
torsion of, i, 367
transvesical opening of, ii, 161
treatment of, in kidney operations, i, 410, 414
after nephrectomy for tuberculosis, ii, 80
tumors of. See Tumors of ureter
veins of, i, 171
X-ray in diagnosis of disease of, i, 362
- Ureteral branches, development of, i, 103
Ureteral calculus. See Calculus, ureteral
Ureteral fever, i, 269
Ureteral fistula. See Fistula, ureteral
Ureteral orifices, abnormal, opening into Fallopian tube, ii, 347
abnormal opening into female urogenital tract, ii, 338
opening into Gartner's duct, ii, 347
opening into rectum and cloaca, ii, 348
opening into uterus, ii, 347
opening into vagina, ii, 341
opening into vestibule of vagina, ii, 343
difficulty in finding, i, 266
dislodgment of stone lodged in, ii, 160
finding, with water cystoscope, i, 297

- Ureteral orifices, implantation of, into rectum for exstrophy of bladder, ii, 400
 method of finding, i, 263
 variety in appearance of, i, 265
- Ureteritis, due to rupture of kidney, ii, 297
- Ureteritis cystica, ii, 349
- Uretero-ureteral anastomosis for ureteral fistula, ii, 437
- Uretero-vesical anastomosis for ureteral fistula, ii, 438
- Ureters, catheterization of. See Catheterization of ureters
 discharge of urine from, i, 263
 implantation of, into bowel for exstrophy of bladder, ii, 396
 influence of closure of, upon renal tuberculosis, ii, 40
 influence of open, upon renal tuberculosis, ii, 41
 methods of treating in extirpation of bladder for cancer, ii, 551
 tuberculosis of. See Tuberculosis of ureters
- Urethra, absence of, ii, 564
 anatomy of female, ii, 370
 anomalies of, ii, 564
 arteries of, ii, 371
 bacteria in, i, 229
 caruncle of. See Caruncle, urethral
 chancre of, ii, 187
 compression of, a cause of hydronephrosis, i, 526, 550
 double, ii, 564
 examination of, through speculum, i, 247
 extirpation of, for carcinoma, ii, 596, 597
 hematuria due to abnormal conditions in, i, 220
 injection of, in retention of urine, ii, 563
 injuries of. See Injuries of bladder and urethra
 inspection of, i, 243
 length of, in adult woman, i, 248; ii, 370
 lesions in, caused by Bilharzia hematobia, ii, 195
 lymphatics of, ii, 371
 malformations of. See Malformations of urethra
- Urethra, nerves of, ii, 371
 new growths of, ii, 588
 carcinoma, ii, 593
 caruncle, ii, 588
 classification of, ii, 588
 fibroma, ii, 591
 fibromyoma, ii, 591
 mucous polypi, ii, 591
 myoma, ii, 591
 obstruction of, a cause of hydronephrosis, i, 526, 550
 sarcoma, ii, 597
 opening of ureter into, ii, 339
 operations on. See Operations on urethra
 pain in, as means of diagnosis, i, 374
 palpation of, i, 237
 prolapse of. See Prolapse of urethra
 stricture of. See Stricture of urethra
 structure of, ii, 370
 stone in. See Calculus, urethral
 symptoms associated with, in renal and ureteral calculi, ii, 111
 symptoms connected with, in urological diagnosis, i, 374
 syphilis of. See Syphilis of urethra
 vaginal. See Hypospadias
 veins of, ii, 371
- Urethral fistula. See Fistula, urethral
- Urethritis, ii, 579
 acute, ii, 579
 chronic, ii, 580
 external, ii, 582
 symptoms of, i, 374
 treatment of acute, ii, 579
 treatment of chronic, ii, 581
- Urethroscopy, method of, i, 247
- Urinary analysis, value of, in pyelitis, ii, 206
- Urinary antiseptics in pyelitis, ii, 207
- Urinary disorders, abnormal condition of urine in, i, 370
 bladder symptoms in, i, 372, 373
 history-taking in, i, 369
 influence of heredity in, i, 369
 pain as symptom of, i, 371
 present illness in, i, 369
 renal insufficiency in, i, 370
 renal symptoms in, i, 370
 reproduction of renal colic in, i, 371
 symptomatology of, i, 369

Urinary disorders, urethral symptoms in, i, 374
 vesical symptoms in, i, 372, 373
 Urinary examination, i, 203
 in cystitis, ii, 451
 in diagnosis of movable kidney, i, 499
 in hydronephrosis, i, 539
 in pyelitis, ii, 206
 in pyuria, i, 218
 in renal tuberculosis, ii, 63
 Urinary organs, physiology of, i, 174
 Urinary tract, abdominal portion of, i, 241
 actinomycosis of. See Actinomycosis
 avenue for infection of, i, 233
 bacteria causing infection of, i, 231, 232, 233, 234
 bacteria in upper, i, 230
 bilharziosis of. See Bilharziosis
 divisions of, for palpation, i, 237
 examination of, by means of Nitze cysto-
 scope, i, 284
 in women, i, 236
 anesthesia in, i, 251
 cystoscopes employed in, i, 277
 by inspection, i, 242
 instruments for, i, 244, 251
 by palpation, i, 237
 by percussion, i, 236
 by sound, i, 237
 technique of, i, 251
 urethroscopy in, i, 247
 palpation of, i, 237
 pelvic portion of, i, 237
 renal portion of, i, 242
 sound in examination of, 237
 syphilis of. See Syphilis
 Urination, character of, with vesical diver-
 ticulum, ii, 375
 difficult, with vesical diverticulum, ii, 375
 interruption of, as symptom of vesical
 calculus, ii, 169
 normal act of, i, 202
 normal frequency of, ii, 555
 frequent, in cystitis, ii, 449
 in neuroses of bladder, ii, 555
 in pyelitis, ii, 205
 in children, ii, 213
 in renal tuberculosis, ii, 58
 as symptom of vesical calculus, ii, 168
 in urinary disorders, i, 373

Urination, painful, in cystitis, ii, 449
 in neuroses of the bladder, ii, 554
 in renal tuberculosis, ii, 58
 as symptom of vesical calculus, ii, 168
 in vesical diverticulum, ii, 375
 Urine, abnormal condition of, in diagnosis
 of urinary disorders, i, 370
 abnormal substances in, i, 205
 acidity of, i, 209
 action of nervous system on secretion of,
 i, 190
 amount of, in health, i, 307
 in renal insufficiency, i, 308
 amount of solids in, in health, i, 192
 bacteria in. See Bacteriuria
 blood in. See Hematuria
 casts in, i, 211
 changes in, with renal tuberculosis, ii,
 59
 character of, during polyuria, i, 185
 chemical characteristics of, i, 204
 chemical and physical characteristics of,
 i, 191
 chemical findings of, in renal insuffi-
 ciency, i, 307, 308
 collection of, from kidney with catheter,
 i, 273
 transvesically, i, 334
 collection and preservation of, for exam-
 ination, ii, 458
 comparison of, from bladder with that
 from ureter, i, 275
 condition of, on both sides in relation to
 operation for ureteral fistula, ii,
 437
 cryoscopy of, i, 310
 electric conductivity of, i, 193
 epithelial cells in, i, 211
 estimation of acidity in, i, 209
 estimation of sugar in, i, 210
 examination of, i, 203
 for bacteria, i, 212
 in pyuria, i, 218
 in renal calculus, ii, 115
 freezing point of, i, 310
 in health, i, 193
 gas in. See Pneumaturia
 hemoglobin in. See Hemoglobinuria
 incontinence of. See Incontinence of
 urine

- Urine, increase of solids in, during polyuria, i, 186
 manner of discharge from ureters, i, 263
 methods of determining renal incapacity by examination of, i, 307
 methods for estimating pus in, i, 215
 method of obtaining, from kidney without catheterization, i, 263, 267
 methods of securing and preserving, i, 203
 microscopic appearance of pus cells in, i, 215
 microscopic examination of, i, 211
 normal amount of, i, 191
 phosphates in. See Phosphaturia
 physical changes in, due to presence of blood, i, 221
 physical characteristics of, i, 204
 in renal insufficiency, i, 307
 preparation of, for microscopic examination, i, 211
 preservation of, i, 203
 proteid bodies found in, i, 205
 pus in. See Pyuria
 rate of secretion of, i, 273
 reaction of, i, 191, 192, 208
 in pyuria, i, 214
 relation between amount of, and blood flowing through kidneys, i, 185
 relation between composition of, and health, i, 307
 retention of. See Retention of urine
 specific gravity of, i, 204
 sugar in, i, 210
 suppression of. See Anuria
 transvesical collection of, i, 274
 transvesical method of collecting, in renal tuberculosis, ii, 68
 turbidity of, in pyuria, i, 214
 in renal tuberculosis, ii, 60
 value of transvesical specimen of, i, 274
- Urinerous tubules. See Tubules
- Uronephrosis, definition of, i, 520
- Urotropin, use of, in acute cystitis, ii, 457
 in chronic cystitis, ii, 460
 before and after operation for vesical calculus, ii, 176
 in pyelitis, ii, 207
 in children, ii, 213
- Uterus, opening of ureter into, ii, 347
- Vaccine therapy, in acute cystitis, ii, 457
 in pyelitis, ii, 210
- Vaccines, autogenous, in pyelitis, ii, 210
 in pyelonephritis, ii, 223
- Vagina, opening of ureter into, ii, 341
- Valentine endoscope, i, 278
- Van Dam's operation, for vesical diverticulum, ii, 381
- Varicocele, with malignant tumor of kidney, ii, 282
- Vasa rectæ, i, 162
- Vascular pedicle, tying of, in nephrectomy for renal tuberculosis, ii, 76
- Vascularization of kidneys. See Renal vascularization
- Veins, of bladder, ii, 369
 of lumbar region, i, 21
 thrombosis of, in prolapsed urethra, ii, 575
 of ureter, i, 171
 of urethra, ii, 371
 renal, anomalies of, i, 436
 arrangement of, in relation to operations on kidney, i, 432
 collecting, of kidney, i, 434
 comparison of, with renal arteries, i, 435
 of cortex, i, 162
 development of, i, 99
 supernumerary, i, 436
- Vena cava, displacement of, in operations on kidney, i, 394
- Vermiform appendix, bacteriuria relieved by removal of, ii, 212
 distinction between concretion in, and ureteral calculus, i, 366
 hydronephrosis due to adhesions of, i, 528
- Vertebræ, relations of kidney to, i, 34
- Vertebral column, curves of, in adult, i, 28
 curves of, in fetus, i, 28
 relation of, to lumbar region, i, 28
- Vesical calculus. See Calculus, vesical
- Vesical diverticulum. See Diverticulum, vesical
- Vesical mucosa, examination of, i, 259
- Vesico-intestinal fistula, pneumaturia associated with, i, 226
- Walker's cystoscope, combined with lithotrite, i, 290

Wassermann reaction, in syphilis of urinary tract, ii, 188

Water, drinking of, in pyelitis, ii, 207
in treatment of renal and ureteral calculus, ii, 137, 138
urine affected by consumption of, i, 307

Water cystoscope, catheterizing of ureters by, i, 298
disinfection of, 294
essentials in, i, 285
examination by, i, 296
in functional tests for renal insufficiency, i, 334
for inspection and irrigation, i, 292
lenses in, i, 287
modifications of, i, 289
optical principles of, i, 287
principles of, i, 284
prism in, i, 288
structure of, i, 286
types of, i, 285
varieties of, i, 289
in vesical tumor, ii, 530

Watson's method for total extirpation of bladder, ii, 551

Wax-tipped catheter. See Catheter, wax-tipped

Wax mixture, preparation of, for catheter, ii, 127

Weiss' table, i, 192

Wolfian body, development of, i, 77

Wolfian duct, development of, i, 75, 78
relation of, to kidney-anlage, i, 83

Wound, closure of, after kidney operations in general, i, 415
after nephrolithotomy, ii, 149
after pyelotomy for renal calculus, ii, 143
in suprapubic section, ii, 183

Wounds, stab or gunshot, of kidney, ii, 303
of ureter, ii, 306

X-ray, aids to use of, i, 125, 349
aids to examination by, for vesical diverticulum, ii, 379
apparatus for, i, 347
bismuth injection as aid to, i, 368
cases suitable for, i, 352

X-rays, collargol injections as aid to, i, 349, 360
distention of bladder in diagnosis by, i, 368
as guide to operation for renal calculus, i, 358
importance of, in urological diagnosis, i, 346
methods of employing in urological diagnosis, i, 346
methods of examination by, i, 348
outfit required for, i, 347
posture of patient in use of, i, 348
preparation of patient for, i, 347
silver iodid injections as aid to, i, 349, 350
stereoscopic pictures in examination by, i, 349
in treatment of sensory disturbances of bladder, ii, 555
use of, in diagnosis of displaced kidney, i, 360
of double ureter, i, 366
of echinococcus disease of kidney, ii, 191
essential hematuria and nephralgia, ii, 6
of hydronephrosis, i, 360, 544, 550
of hypernephromata, i, 360
of horseshoe kidney, i, 360
of inflamed kidney, i, 362
of movable kidney, i, 499
of pyelitis in children, ii, 213
of renal and ureteral calculus, ii, 125, 132
of renal calculus, i, 352
of renal conditions other than calculus, i, 360
of renal disease, i, 352
of renal infections, ii, 222
of renal tuberculosis, i, 362; ii, 70
of rupture of bladder, ii, 491
of stricture of ureter, ii, 352
of ureteral calculus, i, 362; ii, 137
of ureteral dilatation, i, 366
of urethral calculus, ii, 186
of vesical calculus, i, 367; ii, 186
of vesical diverticulum, ii, 379, 381

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>X-rays, use of, in diagnosis of vesical tumor, ii, 531
value of, in operation for renal calculus, ii, 138, 143
X-ray picture, criteria of, i, 351
field covered by, i, 351</p> | <p>X-ray picture, Fenwick's rules for interpretation of, i, 352, 357, 360, 362

Yeast cells in pneumaturia, i, 227
Young's lithotrite, ii, 176</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|

(1)

COUNTWAY LIBRARY



HC 2874 W

